COAL AGE

With which is consolidated "The Colliery Engineer" and "Mines and Minerals"
Published by McGraw-Hill Publishing Company, Inc.
WILLARD CHEVALIER, Vice-President

JANUARY 1937

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● **Round-up:** Next month Coal Age publishes its 26th annual review and progress number. As in the past, the editors, with the generous cooperation of hundreds of operating executives, will give a quick picture of the significant developments in all phases of coal mining during the year just closed, with special emphasis on trends which promise to influence the future of the industry.

● **Work** on the longest drainage tunnel for coal mines in this country—if not in the world—was completed last year when the Pocahontas Fuel Co. holed through the final connection of its 18.6-mile project. The technical story of this development, which provides natural drainage for an area of 12,000 acres, is told in detail in the article which starts on page 3.

● **How** Boone County Coal Corporation revamped its electrical-distribution system to care for increased tonnage, longer hauls and shorter working days will be described in a story by J. H. Edwards scheduled for publication in the March issue. Relocation of substations, installation of a demand meter in the dispatcher's office underground and fully automatic controls are among the changes covered in the detailed story.

● **Chain-mat** conveyors were introduced in underground haulage some time ago. But the new tipple of the Harvey Coal Corporation presents a pioneer application of this type of equipment in cleaning plants. This application is one of the many interesting phases in the modernization story, which includes new all-steel cars, a short-cut haulway and longface pillar recovery, starting on page 12.

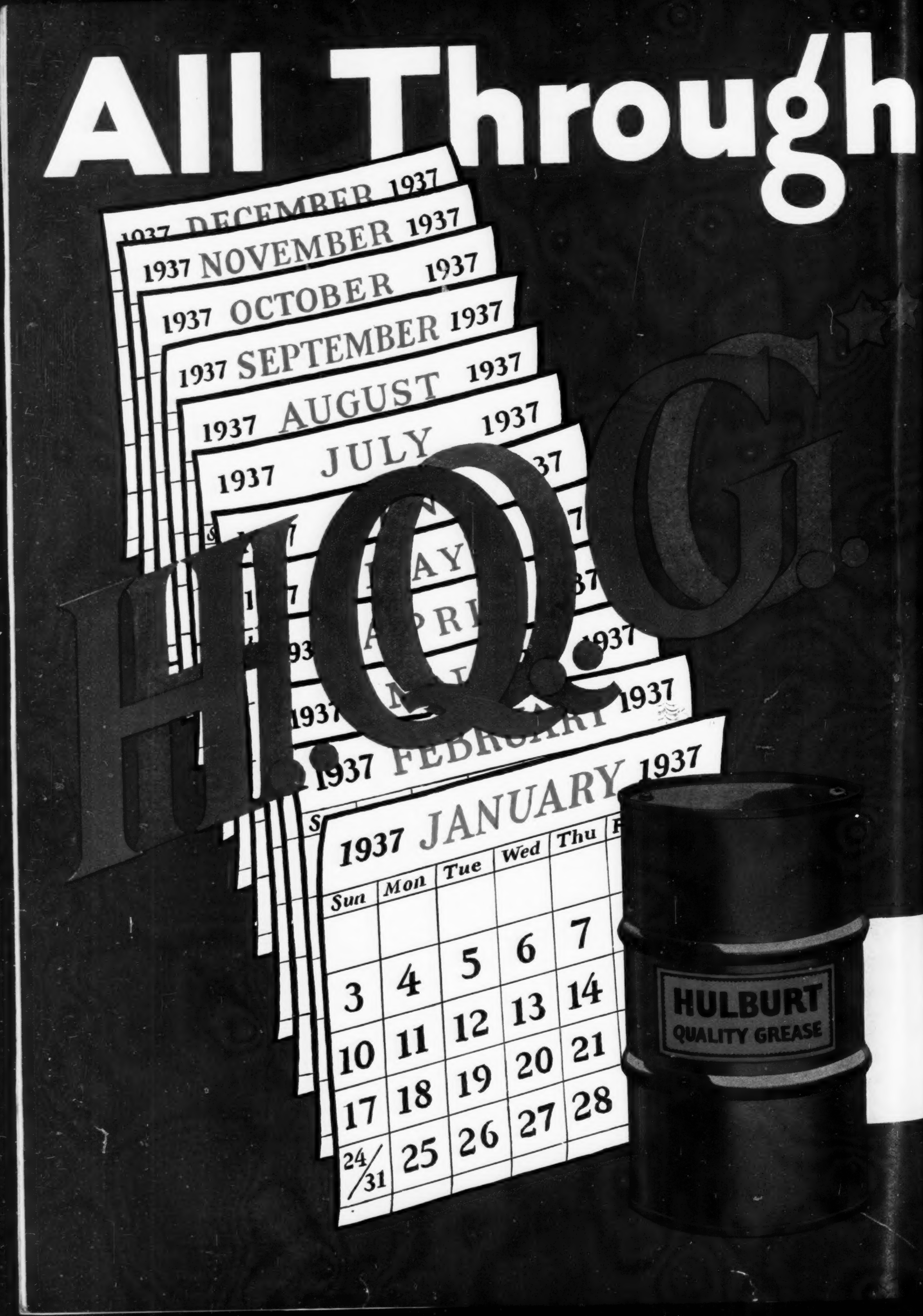
● **Modernization** in the southern Ohio field, effective removal of minus 10-mesh dust from screenings in Indiana and the use of conveyor mining in Illinois are among the subjects upon which stories will be published in the next few months. A follow-up on the Jenkins welding article of last month, which will outline the mechanics of the system, also is scheduled.

● **Confirmed pessimists** on the future of the bituminous industry had better skip the analysis of the outlook in this issue by D. P. Morton, for the author declares that the situation is not nearly as black as it has been painted. On the contrary, he finds that the liquidation of 1924-1929 and the five-day week have exorcised the evil shadow of overcapacity.

COAL AGE is published monthly on the 1st. $3 per year in the United States, Canada, Mexico, Central and South America; other countries, $5, or 20 shillings. Single copies, 35 cents each. Entered as second-class matter Oct. 14, 1936, at the Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in the U.S.A. Cable address: "McGrawhill, N. Y." Member A.B.P. Member A.B.C.

McGRAW-HILL PUBLISHING COMPANY, INC.
Publication Office, 99-129 North Broadway, Albany, N. Y.
Editorial and Executive Offices, 330 West 42d St., New York, N. Y.

Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.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COAL AGE

Established 1911—McGraw-Hill Publishing Company, Inc.

DEVOTED TO THE OPERATING, TECHNICAL AND BUSINESS PROBLEMS OF THE COAL-MINING INDUSTRY

SYDNEY A. HALE, *Editor*

January, 1937

The Weak Spot

NEW RECORDS in the sale of small stokers are becoming almost commonplace. Only a few years ago the oil burner was outselling automatic coal-burning equipment for the home at the rate of nearly 10 to 1; today the ratio approximates 2 to 1. This development is one of the brightest spots in the competitive picture, and one which quite properly infuses fresh optimism and hope in the battle of the fuels.

Cheering as the record has been, however, analysis of sales discloses one weak spot that should be a cause for real concern to those interested in the future of coal as a household fuel. Most of the stoker installations made represent replacement business in existing buildings; in some cases, oil and gas burners have been removed, but in the majority of cases it is apparent that the stoker has been added to coal-burning equipment already installed. But, as was pointed out by Marc G. Bluth in his address before the Illinois Mining Institute a few weeks ago (*Coal Age*, Vol. 41, pp. 597, 599), in the field of new-home building the stoker appears to be running a poor third.

Neglect of this field is deadly. Cultivation of new-home prospects involves not only the presentation of the comforts and economies of automatic heating with coal but also something more subtle and less tangible. Competitive salesmanship has created a feeling that installation of an oil or gas burner is socially desirable. Builders mention such equipment as evidence that the houses they offer are the last word in modernity. Coal and its allies must start a vigorous counter-offensive—even if such attack should necessitate the direct subsidizing of a limited number of new-home community developments.

The situation is potentially too serious to encourage penuriousness in financing the attack. Home building is again on the upgrade and many real-estate and construction authorities believe that a residential boom is in the offing. The longer the counter-offensive is delayed the more difficult it will be to persuade the new-home prospect that it is just as feasible and satisfactory—and much more economical—to keep up with the Joneses with automatic coal heat as with oil or gas.

No Rest

CRYSTAL GAZING is reputedly a hazardous occupation, but one forecast on the future of the bituminous coal industry may be made with equanimity: the first quarter of 1937 will be a busy one for coal-company executives. When they are not journeying to New York to take part in wage negotiations they probably will feel the urge to go to Washington to watch the efforts of the proponents of legislation to resuscitate the Guffey bill. If, between jumps, they can find a spare hour to devote to the immediate problems of mining and selling coal, they can count themselves the darlings of destiny.

Salt for the Mine

WHAT salt might do for the mine needs to be clarified by experiment. Years ago it was used to keep mine roadways damp, incidentally taking water from the air. But dry air is not to be desired. It has no virtue in preventing an explosion, unless water is entirely eliminated, which obviously is impossible. Salt also dries places which have not been salted—another undesirable characteristic. However, it keeps coal dust down and may prevent it from participating in an explosion.

Now that salt well mixed with colloidal clay and granular materials such as coal is being used for "stabilized highways," it would seem reasonable to make use of it also in mines for binding

coal dust to the floor of traveling ways. Rock dust might be spread as before on ribs and roof, where traffic would not disturb it, but clay dust and salt might be distributed on the floor, not to provide an inert dust to extinguish an explosion but to hold down the coal dust and furnish clay for road stabilization.

Few So Clean

ONE of the cleanest of minerals is coal—a fact which seems to call for some explanation, since the peat bogs of prehistoric ages, although generally protected by their vast extent, certainly had the opportunity to acquire impurities in times of flood. Near the extremities of the bed as originally laid down, the coal usually is high in ash. As here used "extremities" should not be confused with the outcrop, for the peat bog may have extended miles beyond its present limits: in fact, the coal often blossoms in what was originally the center of the deposit.

Coal may have been de-ashed by many agencies—worms, the vegetation itself, or by solution. Writing in the *Journal of Paleontology*, Harold W. Scott, University of Montana, declares that certain teethlike fossils, called conodonts by the geologists, are indeed part of the masticatory apparatus of worms. Before that article was penned, the skeptics might well ask: What evidence of worms do you find in Paleozoic times? And the reply could only be that annelids, having bodies which dried and then rapidly decomposed, left no means of identification. Dr. Scott's statement does not prove that worms de-ashed coal but it does bring the probability a little nearer. Annelids were present: what was to prevent them from acting the way of all worms, even though they are of a type now extinct?

Once for All

SINCE unsupported roof in roadways nearly always falls sooner or later and gives trouble, it would seem the acme of management to provide for its support from the first with ordinary concrete, projected concrete or steel arching. Instead, management too often waits for the roof to show its weakness before providing lining or support. As a result, much rock has to be removed, the roadway roof becomes irregular and thus resistant to ventilation and frequently dangerous to the men who travel past it in cars. Some day, of course, it may be possible to inject concrete or other materials into the roof to mend its crevices and cleats and make it unyielding rock, but meantime why not use the means already available for lining the roadway?

Miles of heading have been mended by such means, but it would seem more foresighted to take care of the roof before it shows signs of failure—perhaps with equipment smaller, more portable and equally effective, even if less efficient than that hitherto used for repair. Such a program would reduce accidents, save hauling away rock, give less resistance to air travel, make a more shipshape mine and enable the expenditures to be made with the advance of the roadway instead of at a later period when repair will be an expensive item, interfere with operation and involve a large area in treatment.

Limit of Air Speed

HIGH-AIR VELOCITIES in coal mines lift coal, silicosipathic and other dusts and keep such dust as is lifted in this or other ways in continued suspension. Consequently, air speed should not be based merely on ventilation efficiency, for it has immediate relation to both safety and health. Regulations which went into effect in the Dortmund district of Germany last year permit an increase in air speeds. Formerly the maximum velocity—except in shafts opening to the surface, in airways or in main ventilation roads not regularly used for haulage or traveling ways—was 1,181 feet per minute; under the new regulations this is raised to 1,574 feet.

With a delivery of 100,000 cubic feet of air per minute by the fan, this could be met by two intakes 4½ feet high and 7 feet wide in the clear or with one intake 6 1/3 feet high and 10 feet wide, also within obstruction limits. As nearly all haulage and traveling roadways must lead to the shaft, the regulations practically limit the speeds on all roads except those driven for ventilation only to that stated, unless the roads near the shaft, which, in German mines, generally are through the country rock, are made much larger or more numerous than those through the coal, and such roads are more expensive in construction. W. J. Montgomery's requirements, as stated in his recent book, are not much different: he would allow a speed of 2,000 feet per minute for 100 to 500 feet, and only 1,400 feet for 500 to 1,000 feet, cutting the speed for 1,000 to 2,000 feet to 1,000 feet per minute.

18.6-MILE DRAINWAY

+ Serves Territory Containing 190,000,000 Tons On Pocahontas Fuel Property

LAST September, when the Pocahontas Fuel Co., Inc., Pocahontas, Va., holed through the last connection of its second and most extensive drainway project, it thereby completed a gravity drainway extending 18.6 miles underground through coal and providing natural drainage for 12,000 acres from which approximately 190,000,000 tons of coal can be mined from three seams. For the most part the drainway proper is but one of a group of headings which have been driven for haulage and ventilation. This second project, which was started in 1931, added 14 miles to the total drainway length.

Even the Boissevain mine, which is worked through a 200-ft. shaft and is entirely below local drainage, is dewatered by gravity. On the 14-mile project there was hardly a foot to spare and the drainway portal on Dry Fork is not more than a safe margin above flood stage. Only a small percentage of the coal tributary to the new entry development is below or south of the drainway level and its dewatering will present an easy pumping problem.

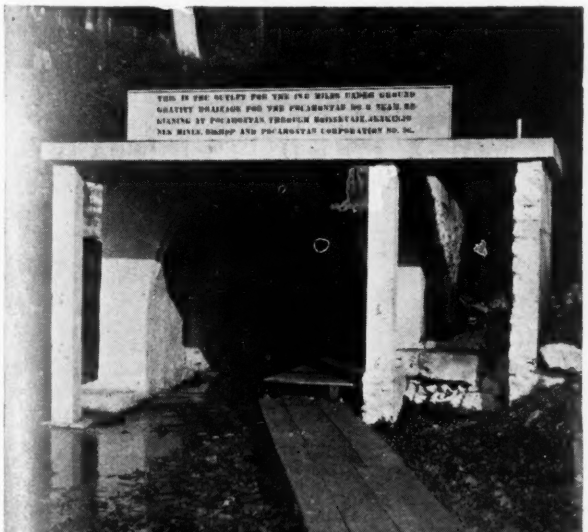
The drainway area comprises the east two-thirds of the most southern of the six Pocahontas Fuel properties (Fig. 1). Generally speaking, the 30-mile southern boundary coincides with the line of upheaval of the Abbs Valley fault. The coal lies in a synclinal basin the bottom of which parallels the fault line and also nearly coincides with it. The drainway is all in the Pocahontas No. 3 seam, which, with the exception of one 2,000-ft. area of low coal, tapers rather uniformly from a thickness of 13 ft. at the eastern end to 3½ ft. at the drainway portal. Other workable Pocahontas seams, principally the No. 4 and No. 5, are present above the No. 3 over large areas of the synclinal tract, especially to the west.

The bottom of the synclinal basin pitches westward at approximately 2 per cent and the synclinal pitch from north to south varies from 1 to 12 per cent. Elevations (above sea level) along the drainway drop from 2,339 ft. at an outcrop haulage drift near Pocahontas tipple to 1,662 ft. at the discharge portal on Dry Fork.

West mine (Figs. 2 and 3), in which the drainage originates, was the first opened in the Pocahontas field (Southwest Virginia Improvement Co., 1881) and coal from that mine was the first shipped over the Norfolk & Western R.R. (1883). Within a short time the company opened two mines adjoining: "Baby" and "East." In 1901 the original company name was changed to the Pocahontas Collieries Co. Organization of an affiliated sales company and of another operating company preceded a consolidation of sales and mining in 1917 into the Pocahontas Fuel Co., Inc. In 1923 a tract of 30,000 acres (that area west of Jenkinjones mine, Figs. 2 and 3) was purchased from the H. C. Frick estate and title to this fee land invested in a subsidiary company, the Pocahontas Corporation.

Dewatering appeared as an early difficulty and soon became an expensive item. Opening of the Boissevain shaft

Left—The drainway portal on Dry Fork is but a foot or two above flood stage of the creek. Right—Openings of No. 35 mine on Dry Fork. Haulage portal at the left and drainway at the right



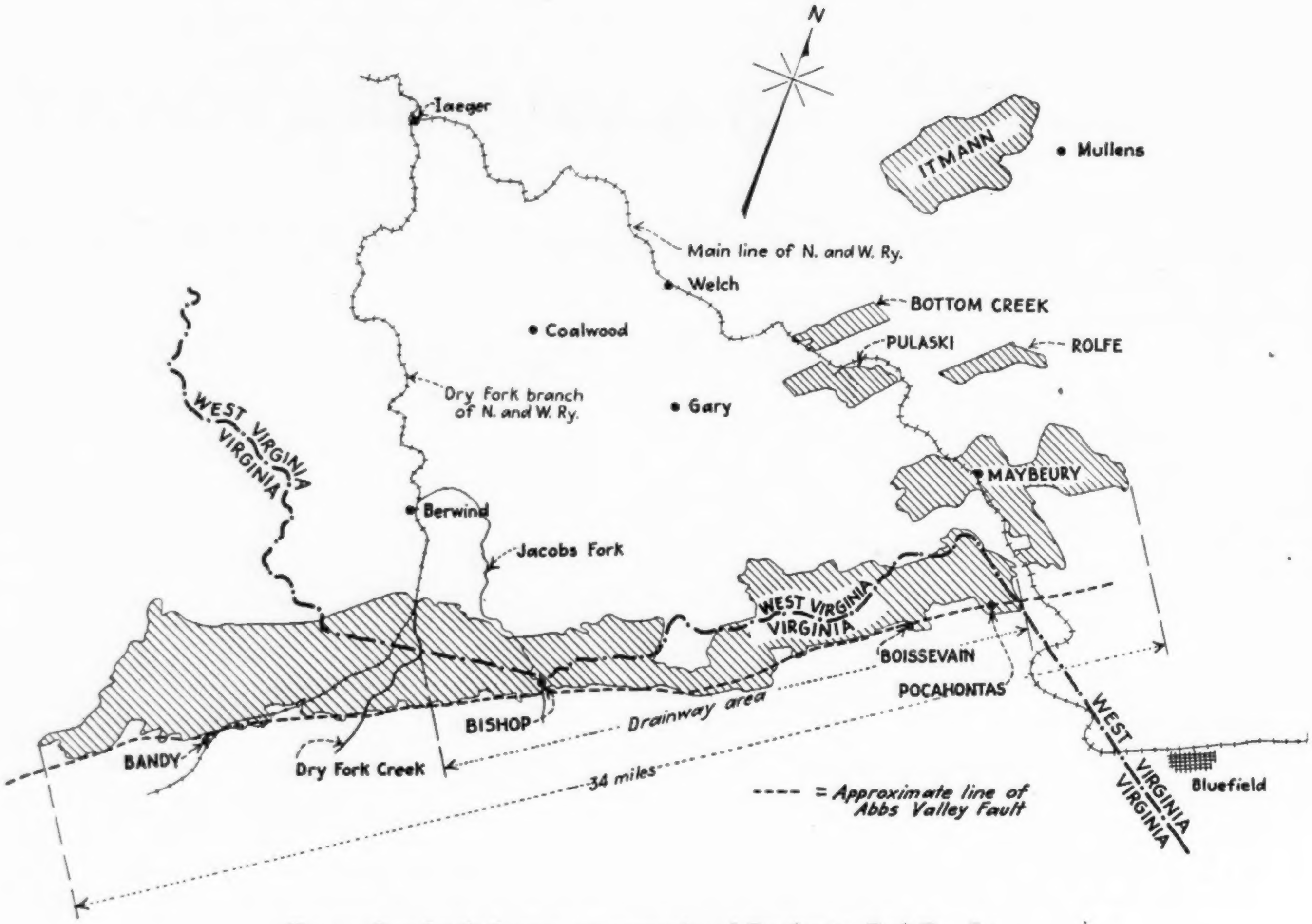


Fig. 1—Cross-hatched areas are properties of Pocahontas Fuel Co., Inc.

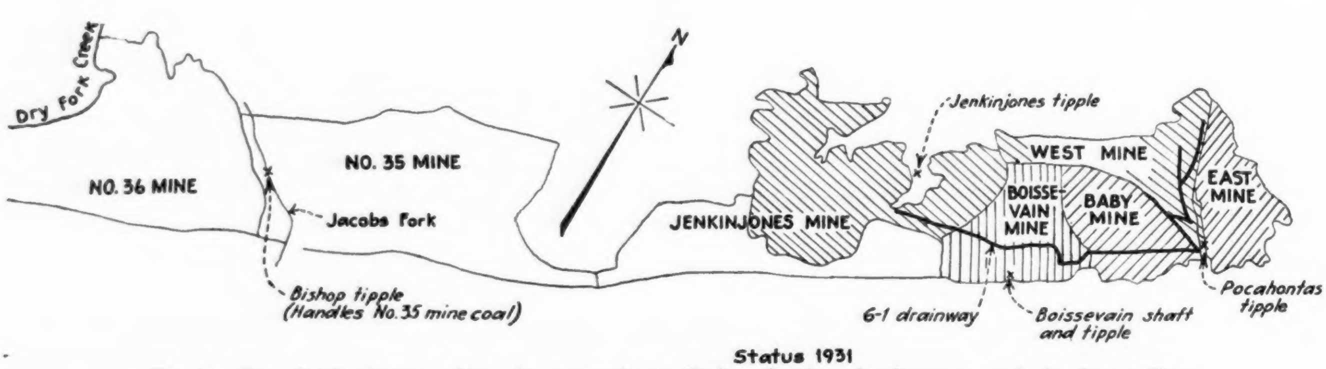


Fig. 2—Cross-hatched areas show the approximate limits of mine development and the heavy lines the first drainway, both as they stood in 1931

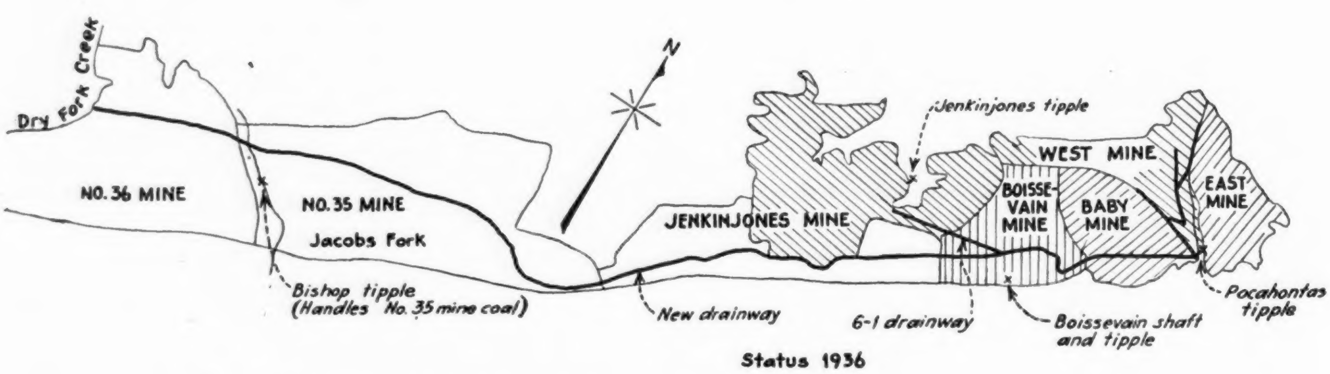


Fig. 3—The 1936 revision of the map shown in Fig. 2; the new drainway connects with the old at a point near the center of Boissevain mine

operation, which is wholly below drainage, brought the problem to a head, and in 1914 a large pumping station (two 5,500-g.p.m. units) was installed at a point close to the boundary between Baby and Boissevain mines. But development in Boissevain indicated an ever-increasing pumping cost, so a project was undertaken to drive headings (designated as 6-1 on Figs. 2 and 3) 18,000 ft. through new and unexplored territory to an outcrop draining to the north near the present Jenkinjones tipple. Coal 6 to 10 ft. thick and favorable mining conditions and markets made it possible to complete the job in two years.

The comparatively new pumping station was thereby placed in the discard, but, fortunately, the pumps and equipment were sold during the World War for considerably more than their original cost. Since the completion of this first drainage project but little pumping has been necessary in the West, Baby and Boissevain mines.

Acquisition of the Frick property lying to the west of Jenkinjones in 1923 stopped plans for a three-mile rock tunnel to drain the vast area of below-drainage Jenkinjones coal to Tug Fork. In the spring of 1924 work was started on the drilling of over one hundred boreholes in the new property and these proved that the 2 per cent westward pitch continued for the full length and that as much as 12 per cent pitch from north to south could be expected.

Locating Gravity Outlet

A pumping plant discharging through an 800-ft. borehole would have been required if a drainway were driven along the bottom of the syncline to take all water to the extreme southwestern corner of the property. Obviously that plan was not advisable if a gravity outlet could be found on Dry Fork which would drain at least a large percentage of the territory to the east and north. An elevation was finally located on the outcrop of the No. 3 seam on Dry Fork which would allow approximately 0.1 per cent favorable grade for the western and difficult end of an eight-mile drainway from the southwest corner of the Jenkinjones mine. A plan to keep the drainway in the coal for the entire distance was predicated on indications that sufficiently uniform seam conditions would be encountered.

Authorization to proceed with the job was given to the mining department in the fall of 1931, but by that time considerable development had been carried on in the Boissevain and Jenkinjones mines in the general direction that the drainway would take. The new work was begun on Jacobs Fork with a pair of outcrop headings driven down the pitch to the calculated drainway elevation, at which point the entry was turned east. Bad roof and considerable water encountered under and near Jacobs Fork gave the job a discouraging start.

Next a 1,900-ft. local area of 22- to 40-in. coal was encountered, and through this section and continuing for 2,800 ft. more only two headings were driven; one the drainway and the other the haulway. No other abnormal areas were encountered in the entire work; therefore all other sections of the drainway development comprise three to six headings, the number depending upon the plans for haulage and ventilation. Figs. 4, 5 and 6 show typical sections in which the numbers of headings were determined by requirements and conditions in the respective locations.

Haulage and aircourse headings were driven on centers but the drainway heading was driven by hand-level exploration to follow the proper grade so as to connect with the next pick-up

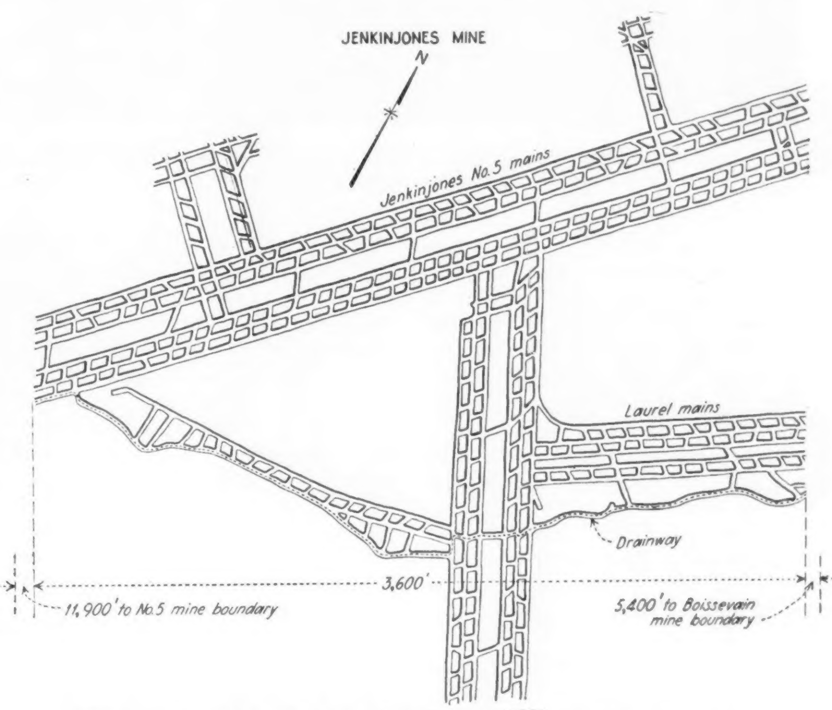


Fig. 4—A section of the drainway in the Jenkinjones mine

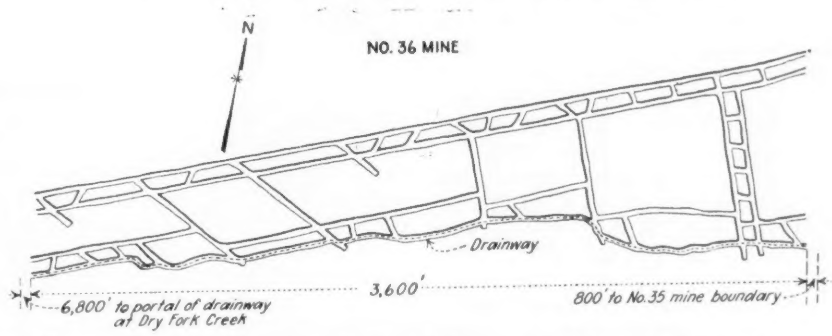


Fig. 5—Four headings comprise the drainway entry through this section of the No. 36 mine

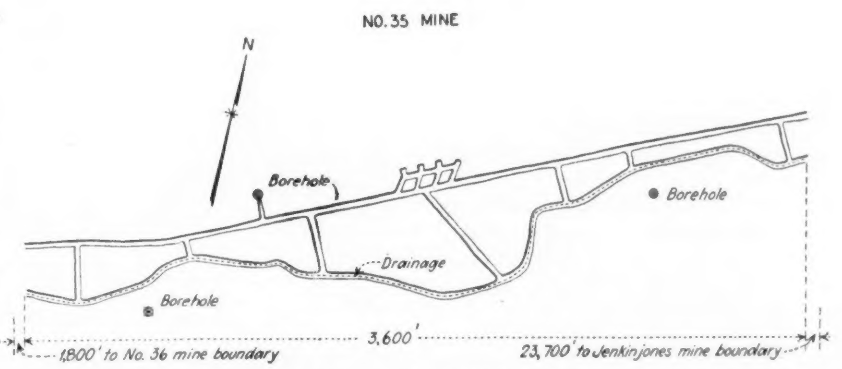


Fig. 6—Through this section of No. 35 mine, which includes a local area of low coal, but two headings were driven

Fig. 7—Posts, headers and lagging of 85-lb. steel rail set on concrete footers will hold the drainway open for its useful life

heading. These pick-up headings, although irregularly spaced and long in some instances, are but crosscuts driven ahead to the points of proper grade. The type of level used by the mining crews in driving the drainway heading consisted of a straightedge board 10 ft. long with an ordinary level set in the center. Elevation guide points consisting of large nails driven into the rib were placed by the engineers. Fourteen feet was the standard width for driving all headings.

Ordinarily three crews—one for the haulage heading, one for the pick-up heading and one for the drainway heading—were employed per shift. An attempt was made to space the pick-up headings by a distance equaling their lengths. When the drainway course followed the indicated path and these distances came out equal as intended, crews were not delayed by waiting for progress in another heading. Except where heading progress lagged behind schedule and a third shift was added to speed progress, two shifts were employed on all work done after 1932. Heading advances averaged 15 to 20 ft. per day (Table I).

Track-Mounted Machines Used

Cutting was done with track-mounted machines, the loading by hand and gathering by cable-reel locomotives. Adequate voltage was provided by advance substations feeding direct current through boreholes. The purchased-power contract calls for the power company to furnish direct current; therefore that company erected automatic substations at the boreholes as required.

In some locations a small quantity of gas was encountered, but the work was completed without particular difficulty. Blowers and tubing were used to ventilate the drainway and other long headings connecting to circulation points.

Steel was used exclusively to protect the top in the drainway heading and was used also along the most dangerous sections of the haulways. Fig. 7 shows the typical drainway construction using 85-lb. rail supported on concrete footers. Concrete columns, steel headers and in many cases treated timber lagging protect the haulway. Fig. 9 shows a section through high coal and particularly bad top which has fallen or has been taken down. Top was taken or bottom lifted to bring haulways to proper grade and 85-lb. steel was used in the track construction.

Through the barrier pillar separating the Boissevain and Jenkinjones mines the only connection is the drainway heading proper and this has been stopped with a 4-ft. reinforced concrete wall having a 1x10-ft. trap drain through the bottom and a 2x2-ft. escapeway opening through the center (Fig. 8). Hinged steel doors ⅜ in. thick seat by gravity on sloping surfaces at both ends of the manhole. Only the door on the Boissevain side is fitted with a hasp which can be locked. A handhole with gravity cover plate provides access for unlocking from the Jenkinjones approach.

In driving the 84 miles of headings of this development that began in 1931, more than a million and a quarter tons of coal was mined (Table I). Just where mine development ceased and drainage began no one can say because the drainway proper is but one of a group of headings which will serve as haulways and airways for the territories traversed.

Celebrating completion of the project, officials of the company arranged trips through the development. On Sunday, Oct. 25, employees numbering 350 were hauled underground the entire

Table I—Drainway Extensions Since 1931

Mine	Distance entry was advanced through new territory, miles	Total length of headings, pick-ups and crosscuts, miles	Total coal mined from headings, tons	Average daily advance of headings, feet	Average thickness of coal, feet
No. 36	2.2	9.07	105,000	20.0	3.5
No. 35	3.8	24.2	314,272	15.0	5.5
Jenkinjones	4.1	45.1	724,640	15.0	6.5
Boissevain	1.04	6.5	112,000	18.6	7.0

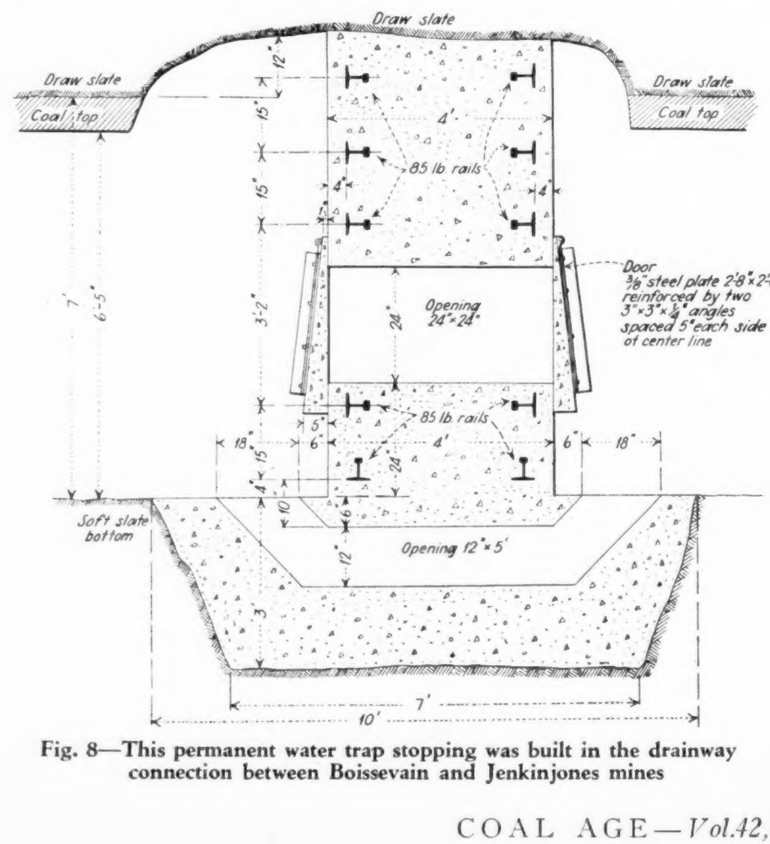


Fig. 8—This permanent water trap stopping was built in the drainway connection between Boissevain and Jenkinjones mines

Fig. 9—Concrete columns, steel headers and lagging were installed to protect difficult sections of main haulways

distance from Boissevain shaft to the drainway discharge portal on Dry Fork near Amonate, where a complimentary lunch was served. On Monday a similar trip was conducted for about one hundred stockholders and on Tuesday the trip was repeated for a group of 200 consisting of invited guests, customers and coal industry men.

Employee Medals Awarded

Deserving employees were presented with bronze medals with individual names engraved and carrying the following inscription: "Commemorating the Completion of the World's Longest Coal Mine Drainway. For Continuous and Efficient Service. September, 1936." Done in relief on the front of this medal, which is 1½ in. in diameter, are the four mine openings showing the men leaving them upon completion of the job.

Because of its pioneering in the field and its large production stretching over more than half a century, Pocahontas Fuel has held a prominent place among producers of the nation. Its present status from the standpoints of unmined tonnage already proved and now developed for main haulage, ventilation and gravity drainage, points to over fifty more years of first rank. O. L. Alexander, of New York, is president of the company and the mining department is headed by W. J. German, general superintendent, who resides at Pocahontas, Va. Engineering is headed by W. A. Bishop, also of Pocahontas.

CAVING CHAMBERS

+ Prevent Water and Gas From Breaking Entry Roof

By ANTHONY SHACIKOSKI
Foreman, Cochran No. 1 Mine
Cochran Coal Co., Salina, Pa.

WHERE, in course of geologic time, the coal measures have broken and slipped down so that one area is at a lower level than an area adjacent, the various strata are no longer continuous, and the water and gas in the section remote from the outcrop often have no way of passing to the surface but are sealed in, occasionally under considerable pressure. When, in such a waterlogged or gas-impregnated area, the coal seam is mined, large masses of roof will cave, endangering life and making maintenance of headings costly, though for a period of three to thirty days, or even longer, after the coal has been removed, roof and gas may give no trouble.

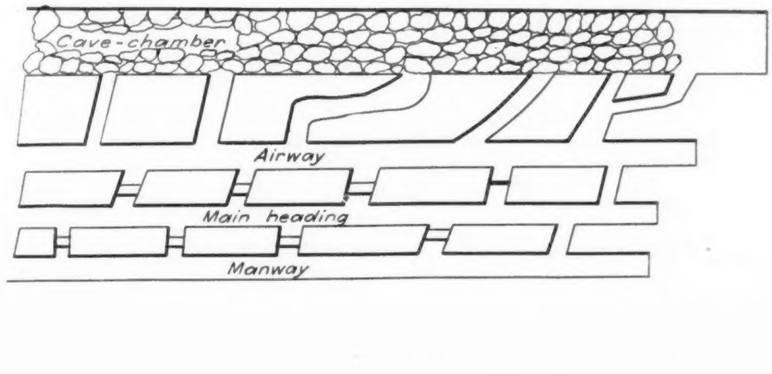
Even during that period, however, some premonitory symptoms of excessive pressure will be exhibited. Small pieces of roof will fall and the bottom will heave, for the water and gas in the floor, as well as the roof, will be under pressure. Eventually 2- to 8-in. roof slabs will break and come down, and the roof will emit a noise like distant thunder, interspersed with periods of quiet. Coal also will slab off the ribs.

This process of demolition will continue for a long period, the roof breaking higher and higher until the water and gas pressures are relieved. In gassy mines, outbreaks of methane will appear in roof and floor, sometimes being emitted from the latter in large quantities. Breakage usually will be most pronounced in the heading which is in the lead. Such conditions, of course, do not exist in all mines, but when they do, serious trouble may be anticipated, justifying some expense in remedial measures.

The best way of meeting this condition is by driving a fairly wide chamber 75 ft. in the lead of all the headings with the express purpose of having it cave promptly so as to relieve pressure. This chamber should be driven parallel to the entry, leaving a good pillar between it and the nearest heading. Because it is likely to deliver much gas, it should be driven over against the return airway, so that the gas will not enter the intake. Another reason for driving the caving chamber alongside the return airway is because rooms usually are turned in the opposite direction, and such rooms when driven will not have to be tunneled through the caves of a caving chamber. As such a room may cave overnight, crosscuts may have to be driven obliquely so that roads will enter the room beyond the cave. To reach the uncaved portion of the room, the pillar may have to be split beyond the last crosscut and a short crosscut be driven through the rib so that the driving of the room can be resumed promptly.

This room must be well timbered to

Fig. 1—Cave chamber and entry adjacent. Rock fall releases water and gas



protect the miners, for in some cases 12x12-in. x 10-ft. timbers have been broken by the pressure. One such room 26 ft. wide broke up to a height of 40 ft. When the room begins to work, rails should be removed and the timber either shut out or pulled out by mechanical means so that it will cave. Should work in the room have to be discontinued for a day or two, timber should be removed and the roof allowed to fall. Meantime, a crosscut should be started at the end of the aircourse so as to provide for the prompt extension of the room, which readily can be done if accurate record has been kept of the distance the working face had advanced ahead of the last crosscut prior to the fall.

With these provisions the heading roof, relieved of weight, usually will stand without damage. Where conditions have not been so severe, I have prevented falls by driving a few rooms parallel to the main entry with a good barrier between the entry and the rooms and by pulling the pillars between the latter. This, however, is a slower way of relieving the pressure. Boreholes from the surface in regions of this kind may meet the difficulty, but rock drillholes in the roof, even 15 ft. long, I found would not relieve the pressure. They merely helped to break the strata where the holes were drilled, making the roof of such roadways unsafe and less easy to maintain.

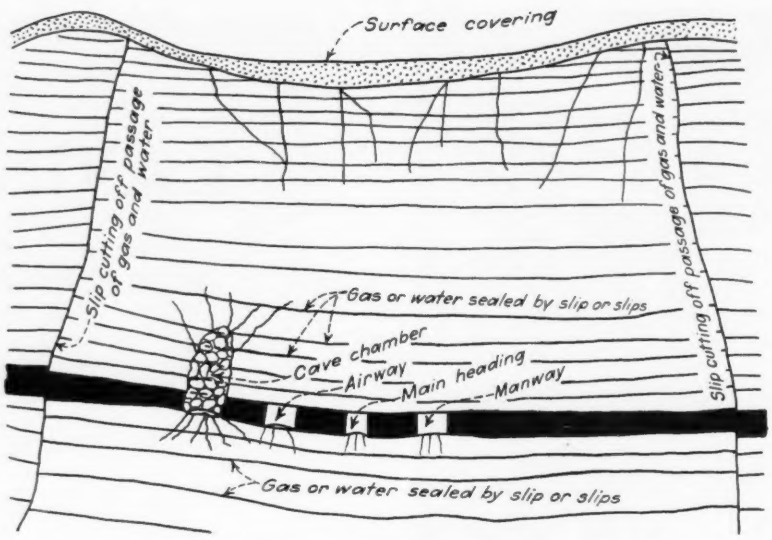


Fig. 2—How slips seal water and gas which can be readily relieved by a caving chamber

MAJOR TRENDS

+ In Power Use and Cost At Appalachian Coal Mines

By T. J. JACKSON and O. G. CROW

Consulting Engineers
West Virginia Engineering Co.

AFTER the general employment of electric power in coal mines began, at the turn of the century, there developed a growing need for a definite study of the use made of such power and its cost, and the effect on these of the various trends within the industry. During the early years of the use of electricity for coal mining, only very meager information was available, but in 1918 engineers of the West Virginia Engineering Co., sensing the need, and with the cooperation of its clients, began a yearly analysis of power use and cost.

The scope of the analysis was enlarged and more coal companies from many Appalachian bituminous-coal-mining States were included in the study from year to year until by 1923 the items of data collected and the coal companies cooperating had become stabilized and comparable data could be collected from practically the same group of mines. Since that time this analysis has been made each year, covering some 400 mines, principally in West Virginia, Virginia, Kentucky and Tennessee, with a few in Ohio and Pennsylvania, and published in convenient confidential form for use as a "yardstick" by the coal-mining industry.

This article, based on these analyses, gives a comprehensive picture of the trends in power use and cost in coal mining during the last thirteen years. The analyses cover mines employing central-station power and mines employing individual private plants (Table I). The former are greatly in the majority. Because of the large variation in the comparable use of power between small mines and large ones, the mines using central-station power have been divided into five monthly tonnage classes, ranging in output from the 0 to 5,000 tons per month class to the very largest tonnage class.

Mines of all tonnage classes using central-station power purchase it at the prevailing power rate in their immediate territories. During the last ten years all of the central-station power rates, or tariffs, have been bilateral; that is, rates have included a demand charge based on a definite interval demand plus an energy charge with a block price scale. The records for these mines do not carry any fixed charges for any equipment

used at the plant as such, but the demand portions of the power charges are usually considered as the fixed charges on the generating and distributing facilities that are required to supply the power.

Tabulations for mines employing individual private plants have been recorded so as to be as nearly comparable as is practicable to those using central-station power. However, no fixed charges are carried on the individual plants for the reason that the methods of making them are extremely variable at the different mines, and at some the entire power-house investments have been retired.

What the Record Shows

Analysis of the record of the average mine in each class for each year from 1923 to 1935 shows:

1. In general, the monthly demand of the total plant follows very closely the plant substation (converting) capacity. Thus the plant demand can usually be predicted by a knowledge of the converting capacity.

2. The tons mined per total alternating-current horsepower connected as a rule increases as the size of the mine increases. This indicates the handicap under which small mines operate because of their inability to utilize fully the electrical equipment connected.

3. The demand charge for the last ten years for central-station power has ranged between 25 and 30 per cent of the total power bill.

4. The load factor based on the actual power demand is better for the large mines than for the smaller ones. This indicates a more evenly distributed application of the power load by the larger mines over the entire 24-hour day.

5. Due to the advantages a large mine enjoys over a smaller one, the power cost per ton almost invariably is lower for the larger operation. Power is cheaper per kilowatt-hour due to the use of larger quantities of power, and less energy per ton is used.

6. Companies employing modern private plants equipped with labor-saving devices are obtaining very reasonable operating power costs. Those with obsolete plants and accompanying heavy labor charge have abnormally high operating costs.

From 1923 to 1928, the curves showing the kilowatt-hour use per ton mined for all tonnage classes (Fig. 1) are very irregular and divergent. Two factors were primarily responsible: (1) during that period a large number of the mines were changing from mule haulage and gathering to electrification; (2) the figures probably were affected by the addition of new companies to the tabulation. The records of some mines covered partial electrification one year and complete electrification thereafter. This condition naturally precluded any consistent trend during this period.

Since 1928, a large percentage of mines shown in the record have had complete electrification for haulage and gathering. Further, over this latter period there has been a consistent general increase in consumption of kilowatt-hours per ton for all tonnage classes,

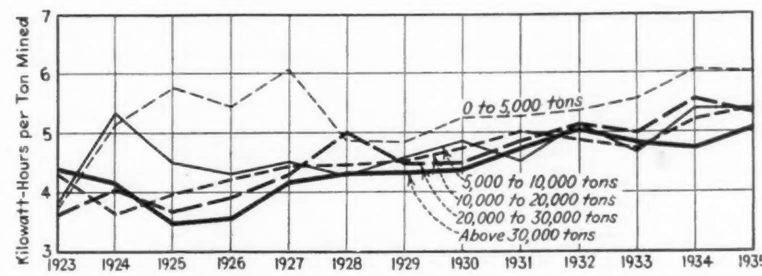


Fig. 1—Kilowatt-hours per ton mined for various tonnage classes

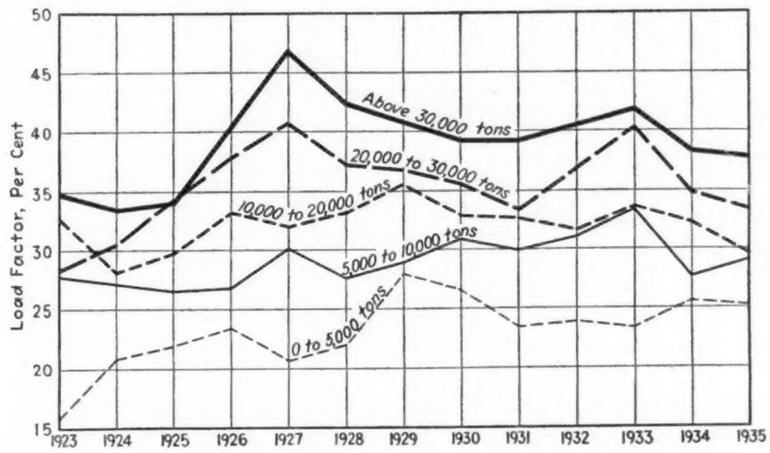


Fig. 2—Load factor based on demand for various tonnage classes

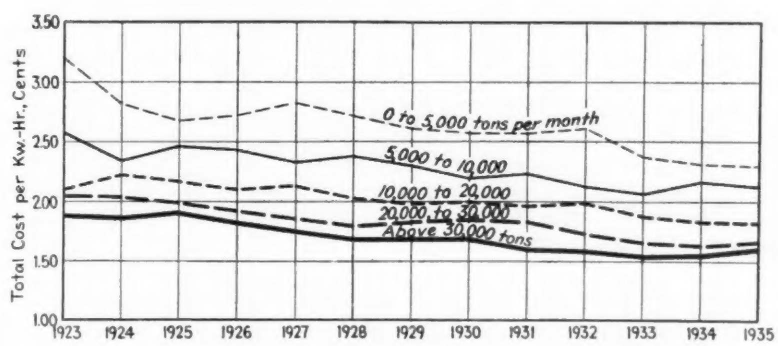


Fig. 3—Total cost per kilowatt-hour for various tonnage classes

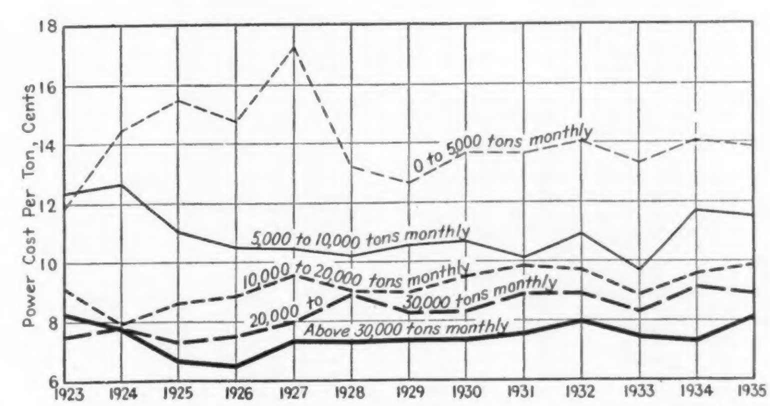


Fig. 4—Average yearly cost per ton for various tonnage classes

particularly in 1933. This general increase can be explained by the increase in power-consuming equipment at the mines for every purpose, and especially for preparation plants. The sharp rise in 1933 can be attributed to increased mechanization inside the mines and a general decrease in the efficiency of power use brought about by the shorter working shift. This decrease in the efficiency of power use has occurred at operations that are producing on only one shift and have found it necessary to mine the same tonnage as before in fewer hours. In order to do this, power-using machinery was suddenly augmented, the main haulage speeded up, and the number of locomotives increased.

The second set of curves (Fig. 2) shows the trend in load factor based on

Table I—Average Monthly Power Use and Cost for Coal Mines for Yearly Periods From 1923 to 1935 Inclusive

Year	No. of Cos.	Avg. Tons Per Month	Substa. Capacity in Kw.	Av. Kw. hr. Purchased Per Month	Avg. Mo. Demand in Kw.	Avg. Mo. Demand Charge, $	Avg. Mo. Energy Charge, $	Avg. Net Total Power Bill, $	Load Factor Based on Demand, Per Cent	Load Factor Based on Conn. Load, Per Cent	Energy Cost Per Kw.h., ¢	Total Cost Per Kw.h., ¢	Per Cent Cost Demand is of Total Bill	Kw.h. Per Ton	Cost Per Ton ¢	Dc. Hp. Con. Per Kw. of Sub sta. Capacity, Hp.	Total Ac. Hp. Con. Per Kw. of Demand, Hp.	Tons Per Total Ac. Hp. Connected	Per Cent of Electri.	Thickness of Seam, Inches
0 - 5,000-Ton Class																				
1923	18	3,251	136.00	12,085	100.80	177.42	210.19	387.61	15.96	9.16	1.74	3.20	45.76	3.72	11.92	1.51	2.74	15.85	93.00	52.00
1924	14	3,442	126.60	17,663	115.80	207.22	289.05	496.27	20.83	13.19	1.64	2.81	41.80	5.13	14.42	1.85	2.18	15.82	94.50	43.00
1925	13	3,707	136.30	21,350	131.90	232.48	342.69	575.17	21.90	15.10	1.60	2.69	40.40	5.76	15.52	1.95	2.21	16.60	94.00	42.40
1926	13	3,410	129.00	18,501	116.00	206.29	297.58	503.87	23.40	15.40	1.61	2.72	41.00	5.43	14.78	2.16	2.35	16.10	95.00	42.30
1927	12	3,112	119.70	18,883	125.00	214.15	321.81	535.96	20.66	11.85	1.70	2.84	40.00	6.07	17.22	1.88	2.42	10.80	94.60	46.00
1928	15	3,372	136.60	16,418	103.90	159.11	286.28	445.39	21.94	11.42	1.74	2.71	35.74	4.87	13.21	1.81	2.92	13.94	87.50	47.00
1929	8	4,027	110.31	19,492	107.50	182.08	327.22	509.30	27.98	13.81	1.68	2.61	35.79	4.83	12.63	1.42	2.65	16.56	88.75	50.00
1930	17	3,640	141.00	19,227	102.10	150.07	354.97	496.21	26.56	13.36	1.85	2.58	28.47	5.28	13.62	2.19	2.99	14.16	95.29	49.00
1931	21	3,877	158.81	20,429	122.40	177.86	348.41	526.27	23.46	12.46	1.70	2.58	33.80	5.27	13.57	2.25	2.61	13.56	95.71	47.29
1932	22	3,398	147.84	18,304	112.70	165.53	327.10	477.58	23.85	12.40	1.79	2.61	34.68	5.39	14.05	2.41	2.55	12.88	98.76	46.73
1933	20	3,547	159.21	19,774	112.50	140.68	332.74	473.42	23.36	11.00	1.73	2.39	29.71	5.58	13.34	2.13	2.80	11.82	93.35	46.85
1934	23	3,744	146.25	22,822	118.40	147.80	379.36	527.16	25.55	13.44	1.66	2.31	28.05	6.09	14.08	2.46	2.68	13.32	96.23	46.50
1935	24	3,452	145.45	20,748	106.97	134.58	343.93	478.51	25.14	12.12	1.66	2.31	28.12	6.01	13.86	2.32	2.94	13.04	95.13	46.88
Total	220	45,979	1,792.97	245,696	1,475.47	2,295.27	4,161.33	6,432.72	300.59	164.71	22.10	34.36	463.32	69.43	182.22	26.34	34.04	184.45	1,221.82	605.95
Avg.	17	3,537	137.91	18,899.69	113.49	176.56	320.10	494.82	23.12	12.67	1.70	2.64	35.64	5.34	14.01	2.03	2.62	14.19	93.99	46.61
5,000 - 10,000 - Ton Class																				
1923	32	7,720	242.00	37,135	220.10	367.41	588.24	955.65	27.67	15.86	1.58	2.57	45.65	4.81	12.37	2.34	2.56	18.15	93.27	52.08
1924	23	7,749	231.00	41,602	216.70	370.31	603.06	973.37	27.08	17.02	1.45	2.34	38.00	5.36	12.56	2.39	2.25	21.20	95.30	54.00
1925	20	7,457	188.00	33,482	185.30	328.10	494.48	822.58	26.50	19.40	1.48	2.46	39.90	4.49	11.04	2.57	1.94	24.00	96.60	53.00
1926	26	7,340	174.10	31,574	171.00	295.86	475.68	771.54	26.76	16.57	1.51	2.44	38.30	4.30	10.51	2.39	2.20	21.83	94.50	48.70
1927	28	7,356	181.34	33,000	156.67	270.83	498.83	769.70	30.06	18.52	1.51	2.33	35.18	4.49	10.46	2.06	2.27	23.15	94.50	47.67
1928	33	7,334	199.10	31,392	160.46	247.41	507.88	747.79	27.56	16.95	1.62	2.38	32.10	4.28	10.20	2.09	2.27	22.07	93.90	50.40
1929	32	7,639	175.80	35,113	169.80	257.28	551.72	809.00	28.88	18.89	1.57	2.30	31.80	4.60	10.59	2.30	2.16	24.57	93.59	50.59
1930	39	7,604	172.73	37,025	166.26	249.01	565.27	814.28	30.97	19.72	1.53	2.20	30.58	4.87	10.71	2.48	2.22	24.46	95.56	49.03
1931	44	7,414	170.10	33,558	159.71	235.14	522.79	752.58	29.92	17.51	1.56	2.24	31.25	4.52	10.15	2.46	2.40	22.88	96.23	51.07
1932	40	7,621	197.82	39,292	182.24	261.77	608.06	837.11	31.05	17.25	1.55	2.13	31.25	5.15	10.98	2.40	2.52	20.26	94.95	49.21
1933	30	7,601	193.65	35,489	149.71	192.62	540.80	733.42	33.44	16.34	1.52	2.07	26.28	4.67	9.64	2.45	2.86	20.01	96.60	47.37
1934	31	7,384	220.37	39,915	198.17	253.87	611.79	865.66	27.63	15.10	1.53	2.17	29.32	5.40	11.72	2.45	2.61	16.86	94.13	48.00
1935	34	7,534	223.03	40,681	192.82	244.79	621.02	865.81	29.09	16.23	1.53	2.13	28.27	5.40	11.49	2.49	2.49	17.43	97.03	44.88
Total	412	97,751	2,569.04	469,258	2,328.94	3,574.40	7,189.62	10,918.49	378.61	225.36	19.94	29.76	437.88	62.29	142.42	30.87	30.75	276.87	1,236.16	646.00
Avg.	32	7,519	197.62	36,097	179.15	274.95	553.05	839.88	29.12	17.33	1.53	2.29	33.68	4.79	10.96	2.37	2.36	21.29	95.09	49.60
10,000 - 20,000 - Ton Class																				
1923	22	17,088	369.00	74,647	335.00	578.91	1,016.74	1,568.42	32.75	20.97	1.36	2.10	36.82	4.30	9.17	2.51	2.26	29.90	92.10	58.64
1924	23	15,055	270.00	54,528	285.20	441.06	768.96	1,180.56	28.05	19.94	1.41	2.22	37.40	3.62	7.93	3.00	2.13	32.50	93.70	59.00
1925	41	14,034	273.80	55,627	264.60	423.65	785.18	1,208.83	29.70	19.10	1.41	2.17	35.00	3.96	8.61	2.83	2.29	30.20	94.50	55.30
1926	42	14,773	266.60	62,400	262.70	433.51	876.06	1,309.57	33.10	20.30	1.40	2.10	33.10	4.22	8.86	2.59	2.27	28.70	93.20	55.40
1927	39	14,075	313.90	62,972	283.08	459.91	894.86	1,342.97	31.99	18.97	1.42	2.13	34.24	4.47	9.54	2.59	2.31	24.80	94.30	54.40
1928	42	14,764	280.00	65,845	277.77	417.35	914.20	1,331.55	33.09	21.19	1.39	2.02	31.35	4.46	9.02	2.75	2.19	27.46	96.00	51.23
1929	42	14,690	267.50	66,595	260.30	397.22	929.72	1,317.48	35.53	21.33	1.40	1.98	29.64	4.53	8.97	2.60	2.30	25.86	95.02	53.45
1930	49	14,545	297.70	68,847	296.90	442.12	945.21	1,378.31	32.88	20.64	1.37	2.00	31.42	4.73	9.48	2.64	2.26	25.16	94.20	56.20
1931	56	15,053	342.10	75,462	325.84	489.05	1,012.72	1,484.30	32.59	19.78	1.34	1.97	32.95	5.01	9.86	2.80	2.35	23.40	95.62	53.18
1932	65	14,543	332.10	70,961	314.70	457.37	978.17	1,414.43	31.66	18.66	1.38	1.99	32.34	4.88	9.72	2.81	2.40	22.29	94.72	53.43
1933	50	14,533	299.50	68,504	277.31	347.37	945.68	1,285.33	33.53	19.45	1.38	1.88	26.99	4.71	8.86	2.66	2.37	24.92	95.82	55.13
1934	49	14,887	334.10	77,602	321.42	416.35	1,011.93	1,428.28	32.19	19.36	1.30	1.84	29.15	5.21	9.59	2.85	2.38	24.76	94.92	51.17
1935	45	14,050	341.30	75,956	331.59	414.70	973.97	1,388.67	29.57	17.95	1.28	1.83	29.86	5.41	9.88	2.40	2.38	22.04	90.61	50.10
Total	565	192,090	3,987.60	879,946	3,836.41	5,718.57	12,053.40	17,638.70	416.63	257.64	17.84	26.23	420.26	59.51	119.49	35.03	29.89	341.99	1,224.71	706.63
Avg.	43	14,776	306.74	67,688	295.11	439.89	927.18	1,356.82	32.05	19.82	1.37	2.02	32.33	4.58	9.19	2.69	2.29	26.31	94.21	54.39
20,000 - 30,000 - Ton Class																				
1923	13	24,516	396.40	88,421	428.60	648.22	1,191.26	1,839.48	28.22	18.75	1.35	2.05	35.25	3.61	7.50	2.62	2.14	33.70	92.70	58.00
1924	12	23,355	395.80	89,468	414.20	632.02	1,196.00	1,828.02	30.50	19.50	1.34	2.04	34.60	4.04	7.82	2.51	2.16	27.90	94.30	56.00
1925	28	24,160	381.50	88,496	367.90	554.10	1,211.45	1,765.55	34.30	21.80	1.37	1.99	31.40	3.67	7.31	2.63	2.15	34.50	92.80	61.50
1926	26	24,981	405.80	97,388	376.10	608.80	1,310.65	1,872.62	37.79	22.89	1.35	1.92	30.00	3.90	7.50	2.90	2.28	35.40	93.30	57.70
1927	27	24,106	372.00	103 291	361.33	588.99	1,376.80	1,922.16	40.86	24.47	1.33	1.86	30.64	4.28	7.97	2.52	2.31	33.32	94.10	59.40
1928	23	24,915	425.00	124,552	452.17	669.54	1,556.77	2,226.31	37.15	24.22	1.25	1.79	30.07	5.00	8.94	2.69	2.15	30.15	96.70	56.54
1929	31	24,189	408.00	109,043	410.20	603.17	1,393.52	1,996.69	36.72	24.03	1.28	1.83	30.21	4.51	8.26	2.73	2.17	30.87	96.77	60.26
1930	24	25,000	428.10	112,449	442.02	646.52	1,436.24	2,082.76	35.49	22.73	1.28	1.85	31.04	4.50	8.33	2.93	2.23	29.29	97.56	55.00
1931	33	24,091	472.70	117,108	479.05	698.81	1,445.48	2,144.29	33.43	20.96	1.23	1.83	32.59	4.86	8.90	2.72	2.26	25.13	95.79	54.36
1932	21	23,915	488.20	123,374	455.68	682.30	1,487.45	2,137.26	36.80	19.95	1.21	1.73	31.93	5.16	8.93	2.52	2.58	24.56	97.95	51.66
1933	32	24,317	420.40	121,643	410.04	512.58	1,504.80	2,017.38	40.27	21.84	1.24	1.66	25.42	5.00	8.30	2.70	2.48	26.64	98.00	52.07
1934	33	24,275	486.80	135,391	526.04	650.38	1,572.22	2,222.60	34.84	21.33	1.16	1.64	24.76	5.58	9.16	2.61	2.32	23.29	97.64	50.03
1935	36	24,684	507.10	131,672	533.86	663.63	1,539.53	2,203.16	33.43	20.23	1.17	1.67	30.12	5.33	8.92	2.70	2.34	24.27	97.39	53.25
Total	339	316,504	5,587.80	1,442,296	5,657.19	8,159.06	18,222.17	26,258.28	459.80	282.70	16.56	23.86	398.03	59.44	107.84	34.78	29.57	379.02	1,245.00	725.77
Avg.	26	24,346	429.80	110,946	435.17	627.62	1,401.71	2,019.87	35.37	21.75	1.27	1.83	30.62	4.57	8.29	2.67	2.27	29.16	95.77	55.83
30,000 - Ton and Above Class																				
1923	10	51,850	1,110.00	228,142	874.00	1,452.75	2,839.62	4,292.37	34.90	21.33	1.24	1.88	33.98	4.39	8.28	2.95	2.31	29.65	97.53	62.00
1924	7	44,444	836.00	186,305	764.50	1,295.42	2,174.12	3,469.54	33.50	22.90	1.17	1.86	37.30	4.19	7.81	3.10	2.01	31.00	98.60	59.00
1925	13	49,482	752.00	172,601	694.90	1,167.46	2,113.07	3,280.52	34.10	21.30	1.22	1.90	35.60	3.49	6.64	2.76	2.29	34.60	91.50	62.40
1926	21	50,817	722.60	180,860	630.40	1,058.28	2,229.60	3,287.88	40.44	23.15	1.23	1.82	32.20	3.56	6.47	2.72	2.41	35.85	91.30	57.90
1927	22	40,039	592.00	167,762	509.40	832.02	2,145.40	2,939.60	46.94	25.82	1.28	1.75	28.31	4.19	7.34	2.82	2.38	35.70	94.70	58.80
1928	29	39,094	572.80	168,028	561.30	840.94	2,030.26	2,842.20	42.48	25.54	1.21	1.69	29.63	4.30	7.27	2.86	2.36	34.25	93.90	60.60
1929	27	37,791	508.30	163,350	547.50	818.91	1,981.62	2,768.70	40.84	26.48	1.21	1.69	29.82	4.32	7.33	2.81	2.13	35.02	82.50	60.10
1930	31	40,157	595.20	175,194	602.80	898.14	2,083.87	2,953.04	39.30	23.94	1.19	1.69	30.41	4.36	7.35	2.83	2.28	31.89	95.19	63.10
1931	23	41,946	641.30	198,433	660.70	1,103.63	2,117.85	3,173.50	39.39	23.89	1.07	1.60	34.77	4.73	7.57	3.09	2.26	30.22	96.70	59.13
1932	31	40,367	746.80	204,283	658.40	1,045.78	2,348.86	3,225.97	40.55	23.58	1.15	1.58	32.46	5.06	7.99	3.08	2.37	28.51	97.06	53.63
1933	19	40,618	737.50	206,018	629.10	776.57	2,484.19	3,163.69	41.83	22.81	1.21	1.54	24.52	4.84	7.43	2.84	2.47	27.31	96.37	56.00
1934	14	41,239	681.80	194,503	694.20	853.35	2,167.00	3,020.35	38.36	22.31	1.11	1.55	28.25	4.72	7.32	2.73	2.33	27.13	94.36	60.78
1935	18	39,640	750.00	201,257	750.30	932.13	2,302.70	3,234.89	37.68	20.13	1.14	1.61	28.82	5.08	8.16	2.49	2.56	24.13	97.40	52.87
Total	265	559,484	9,246.30	2,446,736	8,577.50	13,075.38	29,018.16	41,652.25	510.31	303.18	15.43	22.16	406.07	57.23	96.96	37.08	30.16	405.26	1,227.11	766.31
Avg.	20	43,037	711.25	188,210	659.80	1,005.79	2,232.16	3,204.02	39.25	23.32	1.19	1.70	31.23	4.40	7.45	2.85	2.32	31.17	94.39	58.94

PRIVATE POWER PLANTS

Operating Costs Only

Year	No. of Cos.	Avg. Tons Per Mo.	Steam Plant Cap. in Kw.	Mo. Fuel Cost, $	Mo. Operating Labor Cost, $	Mo. Repair Cost, $	Mo. Supply Cost, $	Mo. Total Cost, $	Percentage Fuel is of Total Cost	Cost Per Ton, ¢	Total Hp. Conn. Per Kw. of Steam Plant	Tons of Coal Per Hp. Steam Plant	Percentage Electri.	Thickness of Seam, Inches
1923.......	18	10,104	317.00	......	......	......	......	1,421.63	......	14.10	2.51	24.73	......	......
1924.......	13	22,512	386.00	......	......	......	......	1,692.36	......	7.53	3.02	35.40	93.30	50.00
1925.......	12	23,131	376.00	......	......	......	......	1,876.15	......	8.11	3.03	36.70	89.20	58.50
1926.......	13	20,887	319.60	579.75	646.03	155.93	79.60	1,461.31	39.70	6.99	2.90	41.93	94.30	50.50
1927.......	17	20,607	346.00	787.85	692.28	142.78	135.84	1,688.03	46.67	8.19	3.22	38.15	93.35	52.90
1928.......	13	24,099	439.60	769.67	717.55	88.51	154.83	1,730.55	44.50	7.18	2.79	37.20	93.00	53.50
1929.......	11	21,030	407.00	583.90	602.10	13.34	207.29	1,406.63	41.52	6.69	2.90	36.42	95.70	54.20
1930.......	13	22,484	477.30	844.16	710.73	121.20	163.46	1,642.49	50.73	7.30	2.66	32.71	93.31	57.23
1931.......	10	29,492	687.00	856.72	610.15	59.06	114.67	1,028.18	50.51	6.88	2.67	25.75	89.60	55.30
1932.......	13	25,015	731.20	634.23	601.78	174.13	129.38	1,521.41	45.46	6.08	2.63	27.65	92.00	66.77
1933.......	14	18,204	586.10	625.29	473.39	98.68	140.11	1,175.71	49.07	6.46	2.71	26.93	96.64	53.64
1934.......	15	21,680	567.60	743.47	697.65	265.10	169.47	1,605.92	46.05	7.42	2.72	25.69	97.46	93.33
1935.......	15	25,380	800.40	810.10	816.65	72.69	222.73	1.873.61	43.31	7.38	2.71	22.24	98.58	48.58
Total......	177	284,625	6,440.80	7,325.14	6,368.16	1,191.42	1,517.38	21,123.98	457.52	100.31	36.47	411.50	1,126.44	650.45
Average....	14	21,894	495.45	723.51	636.82	119.14	151.74	1,624.92	45.75	7.72	2.81	31.65	93.87	54.20

demand. Load factor is the relation of the average rate of power use to the highest rate of power use. For example, assume that a mine uses 100,000 kw.-hr. in a month and that the maximum demand as measured by the demand meter is 300 kw.: There are 730 hours (average) in a month; thus the average rate of power use at this mine is 100,000 kw.-hr. divided by 730 hours, or 137 kw. The ratio of this average rate to the maximum rate (i.e., the maximum demand) in this case is 137 kw. divided by 300 kw., or 45.6 per cent, which percentage is called the load factor. If the demand value is relatively low, the load factor will be improved. The effect of good load factor is to reduce the total cost of each kilowatt-hour used because of the inclusion of less demand cost in its total cost.

Load Factor Increases

In general, the load factor for all tonnage classes increased from 1923 to 1927. This is explained by the fact that during this period power demand for billing purposes was not measured but was based on the rating of the connected equipment, and with practically the same equipment installed over this period (or at least so taken for billing purposes), the use of more kilowatt-hours naturally caused a betterment in the load factor. In 1927 central-station power companies began the practice of measuring actual demand for billing purposes by means of demand meters. The result was that load factors generally decreased until 1930, because the previous assumed demands based on equipment sizes were too low.

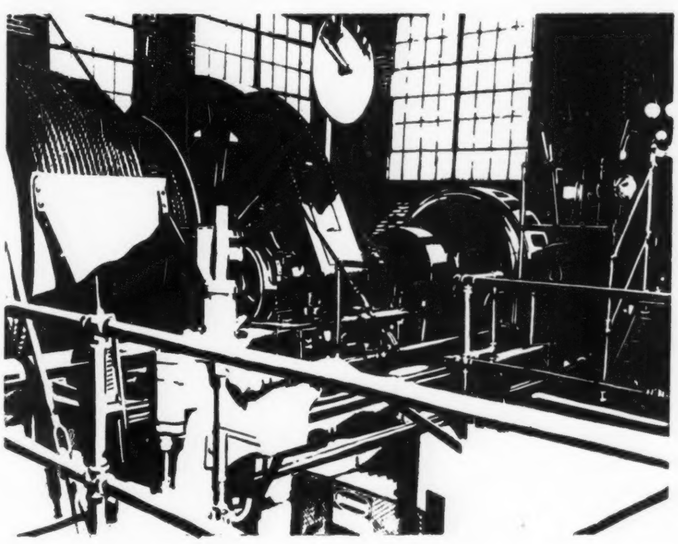
In 1930, marked regulation of power demand by means of demand limiters was instituted by operating coal companies. The result was a betterment in load factors, lasting until 1933. During that year the institution of the short shift made regulation of demand to any appreciable extent impracticable, and since that time load factors have tended to decrease. This decrease has been materially accentuated by the increasing number of cleaning plants, which have a very poor electric load factor.

The curves of total cost per kilowatt-hour for central-station power for the various tonnage classes (Fig. 3) show a definite decreasing trend. This trend may be attributed in part to rate reductions, but a large portion of it has been due to the increasing use of kilowatt-hours which are purchased in the lower-price brackets of the energy scale. The intelligent regulation of the power demand by coal mining companies also has helped materially. This last fact is clearly brought out by the general absence of change in the curves from 1933 to the present time, despite the handicap introduced by the reduction in number of working hours per shift.

The curves showing the cost of power per ton of coal mined over the thirteen-year period (Fig. 4) indicate no marked change, except that since 1933 there has been a general upward trend. In studying the tabulations and the foregoing curves it is evident that, concurrently with a gradual increase in kilowatt-hours per ton of coal mined (as a result of increased mechanization and regulation of the industry), there has been marked progress within the industry in the efficient and intelligent use of power. Able technicians watching and analyzing power costs and insisting on more efficient equipment have been largely responsible for this progress.

The net result during this period has been a comparatively constant record of cost per ton. With great strides forward in mechanization already a fact and greater ones predicted by some for the near future, it is clearly indicated that the kilowatt-hour use per ton may continue its upward march as the mines grow longer and larger. In the face of this, in order that the curve of cost per ton may be kept at an even value, an increase in the efficiency of power use must take place.

There are present large possibilities for such progress. Waste must be eliminated. The efficiency of each power-using device should be measured and steps taken toward improving it. Better methods of using machinery should be sought. The cooperation of manufacturers of equipment should be asked in reducing power use and maintenance costs. In the use of electric power, the coal-mining industry is lagging behind other industries. This may be due largely to the effect of former use of isolated individual power houses, where efficiency was not an important consideration. However, under present-day mining conditions, where power cost is such a large item in the total cost of coal, the operator with low power cost has a decided advantage in the industry.



TIPPLE DESIGN

+ Of Harvey Improvement Program Incorporates Chain-Mat Rescreener

LOOKING forward to mining between eleven and twelve millions of tons in the next thirty years, the Harvey Coal Corporation, of Harveyton, in the Hazard field of eastern Kentucky, is completing an improvement program in which over $70,000 was spent in the last two years and approximately $145,000 in the last five years. In a new tipple rated 425 tons per hour the screening, picking and mixing facilities are attained with a simplicity marked by a design which places the mixing conveyor between the picking tables and loading booms and uses a new development: the chain-mat rescreening conveyor.

Three hundred all-steel drop-bottom mine cars and a short-cut haulway traversing a 400-ft. steel bridge 105 ft. above the creek are among the other major improvements. Mining methods include the extensive use of Cardox and a long-face pillar-recovery scheme which concentrates production. Installation of closed lights was the final touch

Work No. 6 Seam

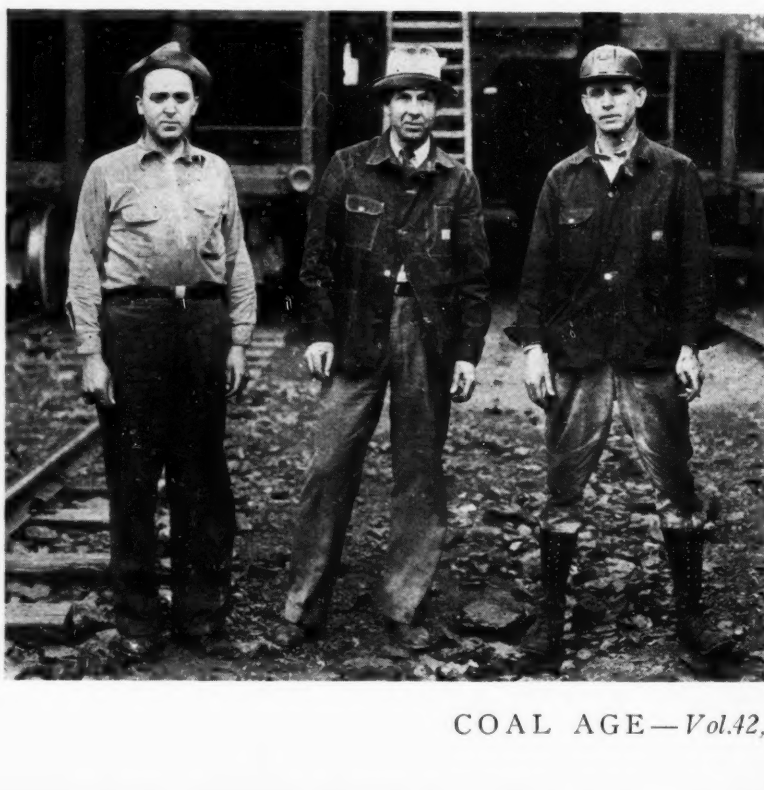
The mine territory consists of a connected group of irregular areas of Hazard No. 6 seam bounded by outcrops (Fig. 1). When opened in 1915 by the Harvey Coal Co. the original tract included 1,750 acres of workable coal. In 1917 the mine was leased to the Hazard-Jellico Coal Co., but in 1924 it was repossessed, and at that time the Harvey Coal Corporation was organized as the operating company. Acquisitions of adjoining tracts in 1930 and 1936 replenished the acreage and brought to over 2,100 acres the total of unmined coal available to the Harveyton plant within a haul of five miles. The latest acquisition—No. 8 mine of the Daniel Boone Coal Corporation—included 60 miners' houses and a store which will be utilized for Harvey Coal Corporation employees (Camp No. 2, Fig. 1). At 2,000 tons per day and 350,000 tons per year the Harvey mine has a projected life of over thirty years.

Average thickness of the seam is approximately 52 in., but there is an increase to a maximum of 100 in. at the distant end of the property. A 2-in. hard bone parting 8 to 10 in. from the bottom and a 2-in. pack rock (very hard) 24 in. from the bottom constitute regular impurities which must be separated from the coal. Inherent ash is below 4 per cent and the markets are steam and domestic, all to the north, and a considerable percentage of the domestic shipments go into Iowa.

The old tipple, rated 200 tons per hour and making four grades, had become inadequate from the standpoints of screening capacity, picking surface and mixing facilities. Because much of the original wood structure was in good condition and a few items of the equipment—the crusher, for instance—were installed but a few years ago, the engineering problem was to work out a design which would make use of certain units of the old equipment without in any way penalizing efficiency of the new plant.

The original tipple trestle, built from hewn timbers in 1914, before the railroad was completed, included one 100-car-capacity bin for receiving coal from the drop-bottom cars. Another bin of the same size was added in 1928. Since through the years this had proved a satisfactory arrangement, it was decided to retain these features in con-

Left to right—H. M. Gallaher, chief engineer; F. M. Medaris, general manager, and W. H. Roll, mine superintendent



structing a new plant. Another consideration was that provision be made for adding a cleaning plant at some future time when and if mechanical loading would be substituted for the present hand-loading methods. A general scheme was worked out by the coal-company management and engineering department, but the final plan and all details were designed by the Jeffrey Manufacturing Co., which contracted to build the tipple.

A white oak structure, brush-treated with creosote and sheathed with steel, houses the new plant, but the shaker screens, which are situated in the center of the old trestle and directly below the dump bins, are supported on a self-contained steel frame resting in independent concrete foundations and back-braced to a concrete pier in the adjacent hillside. Apron feeders 4 ft. wide, one 20 ft. long and the other 32 ft., delivering alternately from the two bins to the main shakers, rest on this same steel frame; thus no weight has been added to the burden on the old wood structure.

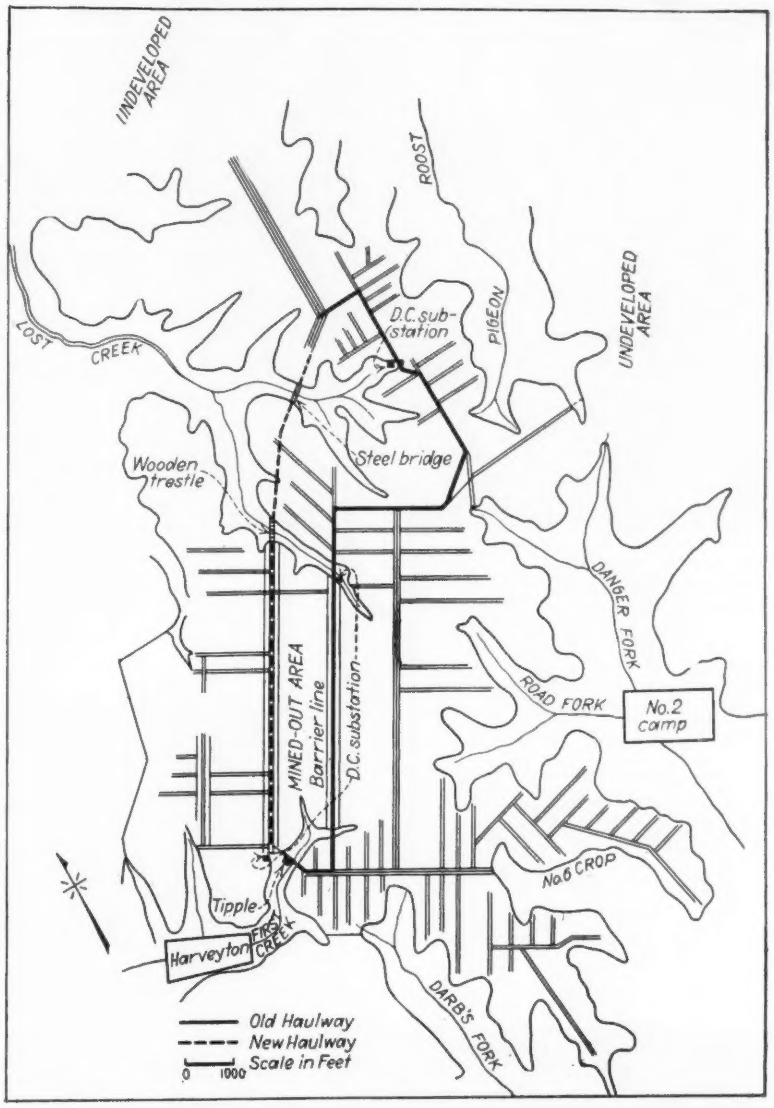


Fig. 1—High bridges reduced by a mile the haulage distance to the undeveloped area

Can Handle 425 Tons

Run-of-mine capacity of the plant is 300 tons per hour, but the screening and conveying equipment is designed for a maximum flow of 425 tons per hour when the oversize, amounting to 125 tons per hour, is being crushed and recirculated to the main screen. Loading four grades on four tracks is the present layout, but provision is made for a fifth loading track if a mechanical cleaning plant is added. Handling the coal with minimum drops, and rescreening to eliminate degradation were primary factors in the design.

Placing the mixing conveyor between the picking tables and the loading booms (see Fig. 2) provides the well-known advantages of structure compactness and simplification of mixing facilities. So far as the coal company's and manufacturer's engineers are aware, the chain-mat rescreening conveyor is unique in this application. These conveyors, one for lump and the other for egg, both operating at 120 f.p.m., are 4 ft. wide by 6 ft. long between centers and the maximum openings are 1$\frac{9}{16}$x1$\frac{3}{4}$ in. A valve plate which by rack and pinion can be moved into a closed position below the upper strand converts the unit into a chain drag conveyor for use in case fine coal fed to it from the upper strand of the mixing conveyor is to be blended with the lump or egg normally passing to their respective booms.

Positioning the chain-mat rescreening conveyor between the upper and lower strands of the mixing conveyor greatly simplifies the handling. With the valve open, the rescreenings drop directly into the lower strand of the mixing conveyor. A new design, two half valves in the upper strand of the mixing conveyor, one half at each side of the rescreening conveyor, serves to distribute the coal to both sides of the center of the mixing conveyor and prevents segregation in the railroad car. Nine-foot hinged sections on the discharge ends of the lump and egg picking-table conveyors provide for change of flow. Raising the end by manual operation of the chain block support diverts the flow from the normal straight-through over the mat-rescreening conveyor to the upper strand of the mixing conveyor.

Fourteen 220-volt a.c. motors totaling 173$\frac{1}{2}$ connected-horsepower drive the plant (Table I). Several of these were formerly in use in the old tipple. All wiring is in BX cable and the magnetic controls are grouped on a central panel and connected so as to effect sequence starting. Three 50-kva. 2,300-110/220-volt transformers installed in a d.c. substation near the tipple supply the tipple power and town lighting circuits.

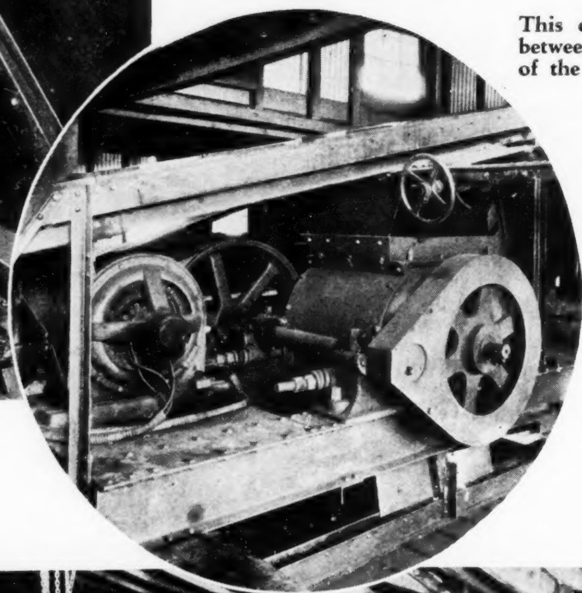
Coal-size yields from the mine average approximately as follows: 5-in. block, 44 per cent; 2x5-in. egg and nut combined, 24 per cent; and 2-in. slack, 32 per cent. Although the coal is firm in character, close study and supervision of face preparation has been necessary to attain these percentages.

For twelve years shotfirers have been employed in the Harvey mine and during that time numerous shooting experiments have been conducted. Three years ago Cardox was installed and approximately one-half of the production is now shot by that method, using the B37 cartridge. It is especially adapted to the long-face gang loading, where shooting is done during the shift and each hole is shot directly after the mining machine has passed that point. Otherwise the coal would "set down" in the cut and thus interfere with the proper action of the breaking agent.

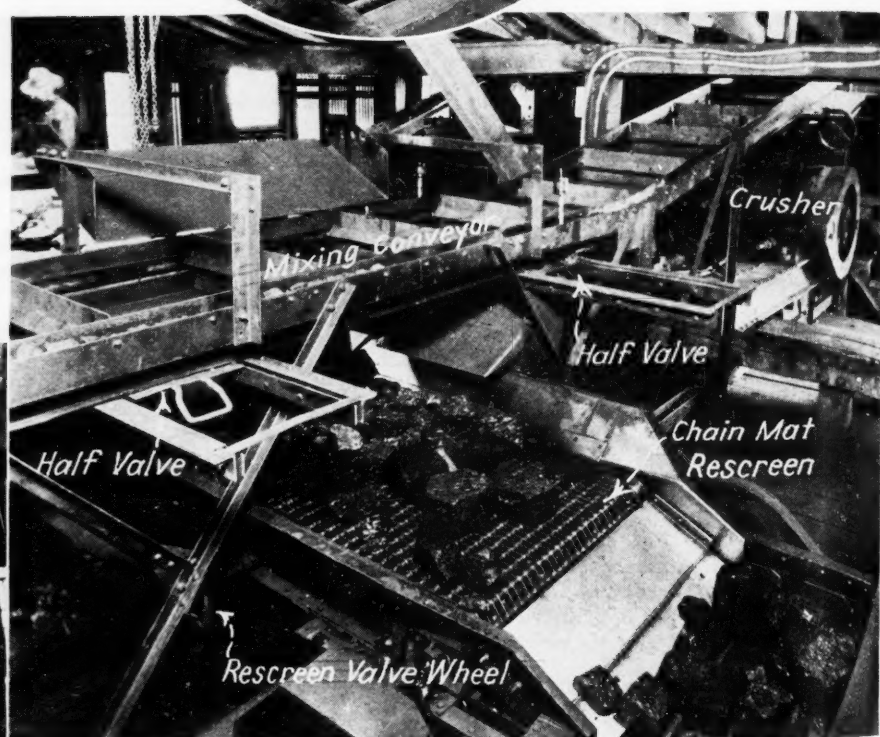
Due to the softer character of the coal near the outcrops and under lighter cover, a quicker agent than Cardox is required; and for these territories 1$\frac{1}{4}$-in. pellet powder is used. Exact control is obtained by assembling the powder charges on the outside where the clay stemming dummies also are made.

Undercutting to a depth of 6 ft. is

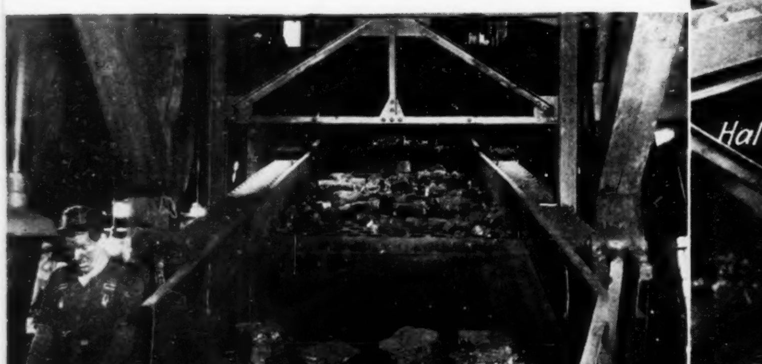
Large surface, even spreading and adequate lighting characterize picking facilities. This view shows preparation of 2x3-in. nut



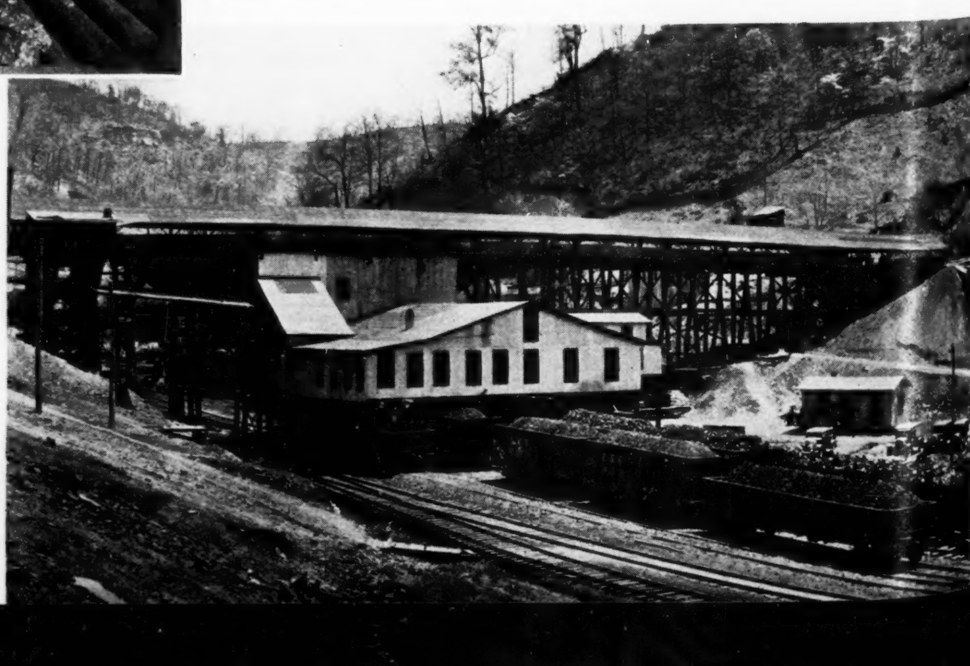
This crusher is placed between the two strands of the mixing conveyor



The chain-mat rescreening conveyor is a new development



The main screen is supported on an independent steel structure between the hewn timbers of original trestle built in 1914 before the railroad was completed



The original trestle and dump bins were retained in building this modern preparation plant

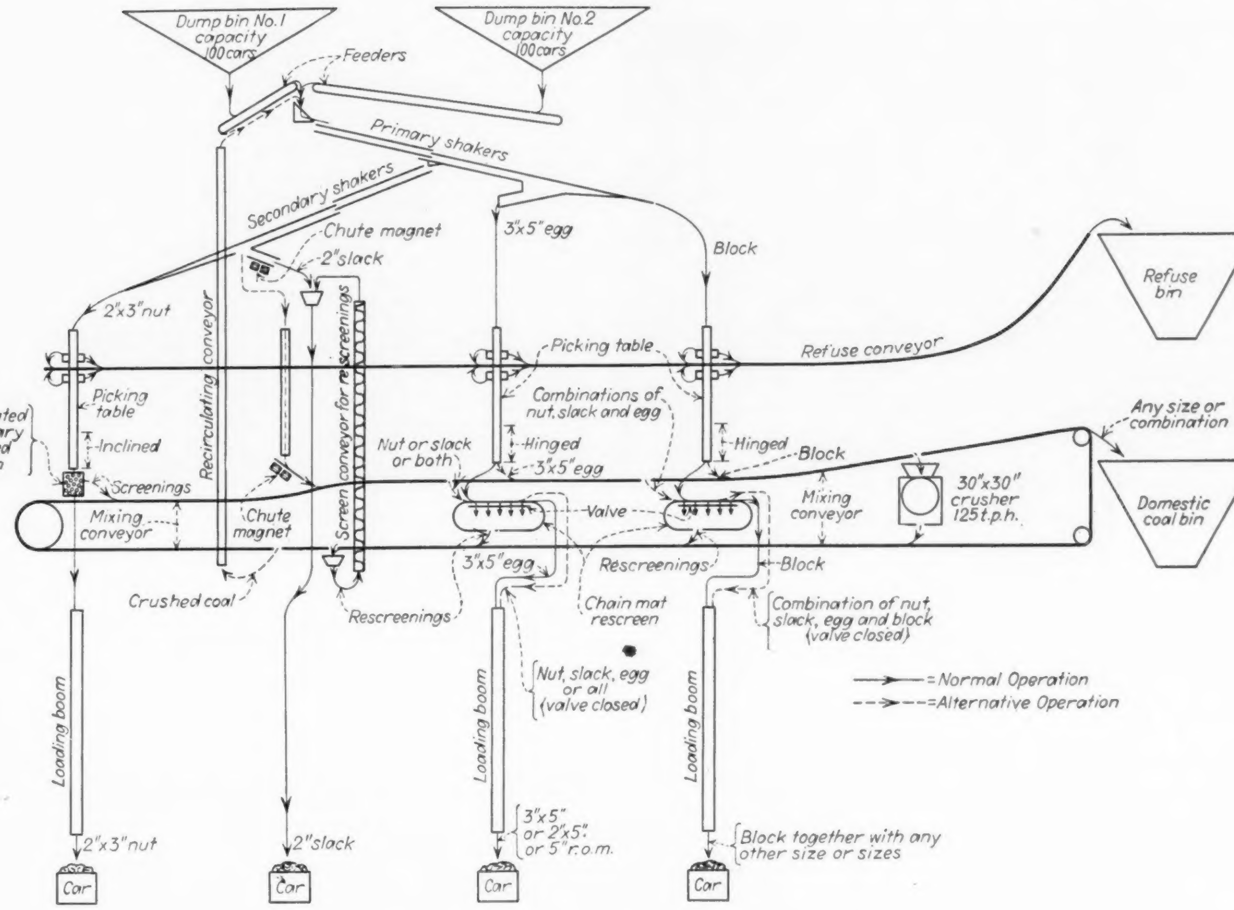


Fig. 2—Flowsheet of the Harveyton plant

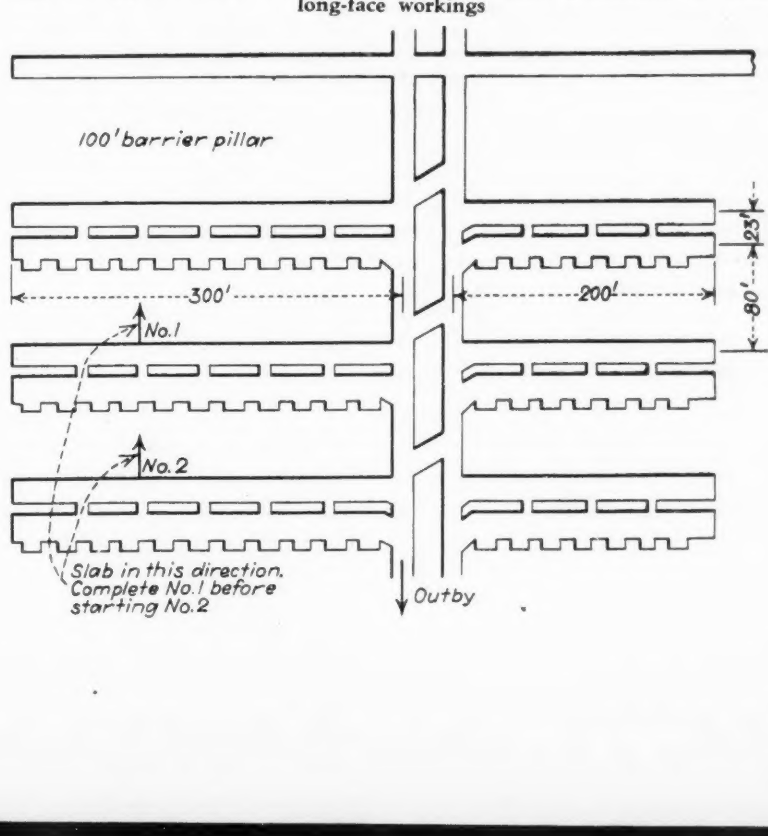
done with Goodman 12AA and Jeffrey 35BB shortwall machines, which are operated on steel-plate skids. The skid holds the machine so that it leaves about 1 in. of coal and thus is protected against cutting into the bottom. Six months ago as an experiment one machine was equipped with a thin-kerf (4-in.) cutter bar in place of the standard bar, which makes a 6-in kerf. This machine operates with less power and decreases the chance of accidental cutting into the bottom or into the bone, which in this small section of the mine is only 6 in. above the bottom.

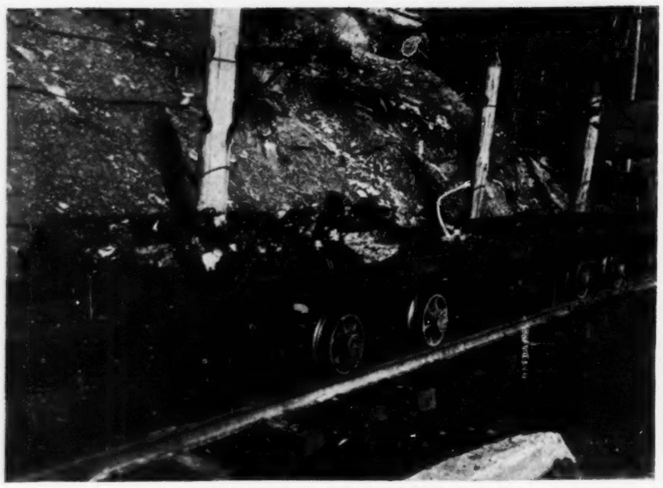
Approximately 30 per cent of the present production of 1,800 tons per day comes from the long-face workings (Fig. 3). The average length of face is 200 ft. and the loading crew (working on a tonnage basis, 46.7c. per ton) consists of thirteen or fourteen men. Ordinarily one man does the timbering and loading for 15 ft. of face. Posts are set on 4-ft. centers with 30 in. clearance from the rail. One row of safety posts is maintained within 4 to 5 ft. of the face.

A panel is developed by driving narrow twin rooms separated by 6-ft. chain pillars. Pockets 6 ft. deep, 12 ft. wide and spaced on 25-ft. centers cut into the solid rib of the outby room when it is being driven facilitate the pillar recovery by slabbing cuts which proceed in an inby direction. These pillars are mined in the retreat order and usually the top caves, without shooting or pulling any posts, when about half of the adjacent pillar has been mined. Chain pillars between the twin rooms and the small stumps between pockets are not recovered.

The 200-ft. section of track consisting of 20-lb. rails on steel ties is skidded ahead 6 ft. after the loading of each cut and the connections at haulage entry are made by a sliding curve point to the outside rail and by a balled rail tangent slip joint to the inside rail.

Fig. 3—Approximately 30 per cent of the mine production is from long-face workings





Left—Three hundred of these new all-steel automatic drop-bottom cars were included in the improvement program. Right—One span of the steel bridge completed early in December, 1936

Harvey mine was a pioneer user of Sanford-Day automatic drop-bottom mine cars and the 300 all-steel cars constituting the new equipment are of the same type and make. The design was, of course, changed to incorporate the latest improvements. Two hundred of the cars, including 100 purchased in 1936, have Timken roller bearings and the other 100 have Fafnir ball bearings. Car capacity is 78.7 cu.ft. water-level and the average loading is 2½ tons. Height above rail is 26 in.; over-all width, 5 ft. 8½ in., and over-all length, 12 ft. 5¼ in. The cars are equipped with wood-filled bumpers and a spring drawbar but are without brakes. The track gage is 48 in.

To shorten the main haulway to the main body of coal by approximately one mile an old entry was extended in a line which crosses two narrow ravines, one at level 105 ft. above the creek bed and the other at 60 ft. A steel bridge consisting of two 200-ft. spans which had served their purpose at a mine in West Virginia was purchased for the higher of the two crossings.

In its new location over Big Branch of Locat Creek the center support of this steel bridge is a wood tower on a masonary foundation. The riveted spans were designed to carry a sixteen-ton locomotive and trip of loaded cars. The vertical distance from the top cord to the creek bed is 130 ft. The other crossing is effected over a timber trestle 350 ft. long. Track for the new haulway consists of 60-lb. rails set on 5x7-in. x 6½-ft. oak ties ballasted with rock. This haulway was driven to a predetermined grade for efficient haulage and to simplify drainage.

Installation of electric cap lamps was begun about eighteen months ago—principally for efficiency reasons. Recently with the acquisition of twenty more lamps to bring the total to 400 (Edison type K) the change-over was completed 100 per cent.

Officials of the Harvey Coal Corporation are: Calvin Holmes, president; M. D. Arnold, vice-president; C. J. Pleming, secretary, and Leo. I. Franz, treasurer, all of Knoxville, Tenn., where the main office is situated. Those headquartering at Harveyton are F. M. Medaris, general manager; W. H. Roll, mine superintendent, and H. M. Gallaher, chief engineer.

Table I—Plant Units and Driving Motors

				Motor				
Unit	Type	Size	Speed	Hp.	Make	Type	Speed r.p.m.	Drive Connection
Feeder No. 1.	Standard apron.	4 x 20 ft.	30 f.p.m.	7½	G.E.	S.C.	1,200	V-belts and spur gears.
Feeder No. 2.	Standard apron.	4 x 32 ft.	30 f.p.m.	7½	G.E.	S.C.	1,200	V-belts and spur gears.
Main screens.	Inclined shaking.	Primary two sections 6 x 25 ft. each.	100 r.p.m. on 6-in. stroke.					
		Secondary two sections 7½ x 13 ft. each.	160 r.p.m. on 4-in. stroke.	30	G.E.	S.C.	900	Flat belt.
Rescreenings[1] conveyor.	Screw.	9 in. x 36 ft.	40 r.p.m.					
Lump picking table.	Curved apron flights.	5 x 33 ft. including a 9-ft. hinged section.	60 f.p.m.	5	G.E.	Gear-motor	1,800-43½	Chain.
Egg picking table.	Curved apron flights.	5 x 33 ft. including a 9-ft. hinged section.	60 f.p.m.	5	G.E.	Gear-motor	1,800-43½	Chain.
Nut picking table.	Standard apron flights.	4 x 33 ft. including a 9-ft. inclined section.	60 f.p.m.	3	G.E.	Gear-motor	1,800-43½	Chain.
Lump loading boom.	Standard apron flights.	4 x 32 ft. including a 28-ft. hinged section.	100 f.p.m.	7½	W.	S.C.	1,200	V-belts.
Lump rescreening conveyor.	Mat.	4 x 6 ft.	120 f.p.m.					
Egg loading boom.	Standard apron flights.	4 x 32 ft. including a 28-ft. hinged section.	100 f.p.m.	5	G.E.	S.C.	1,200	V-belts.
Egg rescreening conveyor.	Mat.	4 x 6 ft.	120 f.p.m.					
Nut loading boom.	Standard apron.	4 x 32 ft. including a 28-ft. hinged section.	100 f.p.m.	3	W.	S.C.	1,200	V-belts.
Mixing conveyor.	Scraper flight.	36 in. wide, 10 in. deep, 72 ft. long.	100 f.p.m.	20	G.E.	S.C.	1,200	V-belts and spur gears.
Refuse conveyor.	Chain drag.	18 in. x 80 ft.	80 f.p.m.	10	G.E.	S.C.	1,200	V-belts and spur gears.
Slack[1] conveyor.	Belt.	36 in. x 30 ft.	....	5	W.	S.C.	1,200	V-belts and spur gears.
Recirculating[1] conveyor.	Scraper flight.	36 in. x 48 ft.	100 f.p.m.	15	W.	S.C.	900	V-belts and spur gears.
Crusher[1].	Single-roll Jeffrey.	30 x 30 in. 125 tons per hour.	....	50	G.E.	W.R.	900	V-belts.

G.E.— General Electric. W.— Westinghouse. S.C.— Squirrel-cage. W.R.— Wound-rotor.
[1] Salvaged from former tipple.

SURPLUS CAPACITY

+ No Longer a Menace

To Bituminous Industry Outlook

By D. P. MORTON
Chief Rating Commissioner
Chesapeake & Ohio Railway Co.

ELIMINATION of excess capacity and reduction of losses to competitive sources of energy have been the most critical problems confronting the bituminous coal-mining industry in recent years. Since affected producers could agree on no group program, the solution of these problems—until the Roosevelt administration intervened—was left to economic law, under which, theoretically at least, only the fit would survive. Although this intervention has twice run afoul of the courts, demand for a revival of legislation to control production and prices again is heard.

Analysis of fundamental conditions in the industry at the present time, however, indicates that the surplus capacity brought about by earlier overdevelopment has practically disappeared under the five-day week. Indeed, some of the coal-producing States are unable to take care of their winter fuel loads. If this analysis, to be discussed in detail in later paragraphs, is correct and if the industry is able to maintain its competitive position, then there is reason for assuming that for the next few years demand will be sustained at levels which will facilitate the healing of an economic sore without resort to legislative opiates.

Recent experiments in federal supervision have depended upon: (1) Wage and labor regulation through definite contracts with a recognized labor organization, (2) price regulation through the establishment of minimums, and (3) the fixing of production quotas as the basis for control. The first feature became actually operative under NRA, when the industry was unionized almost 100 per cent and a limit of 35 hours per week was set for the individual miner. The second feature worked with fair success during the first year under NRA, while the third was tried only to a limited extent under the so-called Adams plan.

These regulatory schemes were designed to limit production and to fix minimum prices which would at least assure the operator a realization equaling his production cost. Nothing is to be gained by reiterating the arguments for and against the theory of market control through regimentation. But upper limits set against production and lower limits set for the sale price of a commodity, if effective, inevitably raise the net cost to the consumer, invite susbtitution and lead to further need for adjusting both the production and price limits. Such a program, over a period of time, could and would destroy any industry.

Although the legislative efforts of the past have proved fruitless, that is not sufficient reason to say that no coal legislation is necessary. The widespread distribution of bituminous coal has contributed largely to the overdevelopment of the industry, and since unmined reserves are of tremendous national importance, adequate conservation of these reserves would go a long way toward stabilizing the coal business. This, however, is a State problem rather than a national one. Roughly speaking, 90 per cent of the bituminous coal mined comes from ten States east of the Mississippi River; 75 per cent is produced in four key States: Pennsylvania, West Virginia, Kentucky and Illinois.

Each large-producing State is interested in protecting those operators who have remained in business furnishing both State revenue and employment, and each State should be vitally concerned with conserving an irreplaceable natural resource. No State, of course, can afford to act alone in imposing legislative restrictions on such a highly competitive industry, but these four key States can and should pass a uniform conservation law which should also control the opening of new and the reopening of old mines. Such a law should be administered for all the affected States by a single, able, nonpartisan commission. This is all the legislative protection—or interference, if you prefer—which bituminous coal needs; this much, however, is necessary to avoid for the future the very causes which led to past overdevelopment.

Since the phrase "normal business" will be used frequently in this discussion, it is desirable to fix the meaning of that term within definite limits. Statisticians have two ways of defining normal. One is to refer the present to some previous year, or mean of a group of years, which has been arbitrarily selected as representing normal volume. The second method recognizes the element of national growth both as to population and the ability of individuals to buy goods. The resultant is an upward trend for the gross business done in the United States and a "normal"

★ ★

What Do You Think?

The author of this analysis of the outlook for the bituminous industry is no amateur on the job. Mr. Morton is not only a graduate mining engineer with several years' practical operating experience but for the past decade he has been using the methods outlined in this article in making annual forecasts of national production. The views and conclusions reached are his own. Whether the reader accepts all of them without reservation—and the editors suspect that some, for example, will challenge Mr. Morton's mine birth-control proposals and that there may be others who may feel that he has underestimated the growth of multiple shifting—Mr. Morton's contribution cannot be otherwise than stimulating, particularly to the executive who is seeking a broad overall picture.

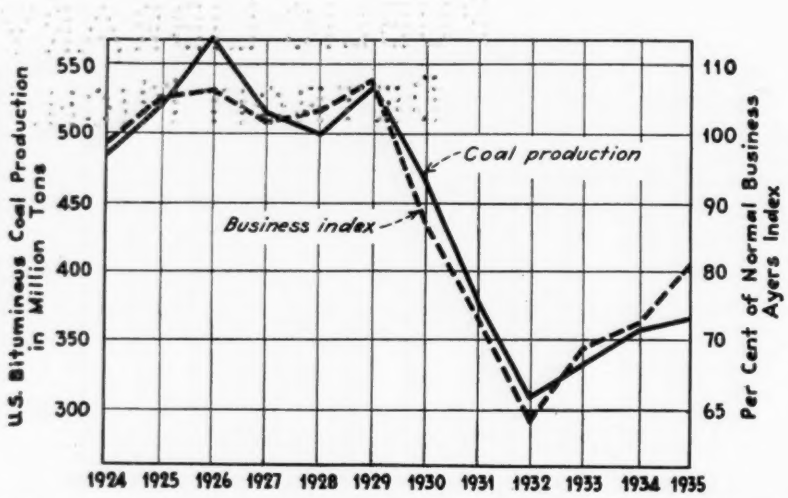


Fig. 1—How bituminous output reacts to fluctuations in general business

which increases from year to year. Statisticians, however, do not agree as to the limit of this uptrend and their disagreement explains the wide variety of business indices published.

The Index of Business Activity compiled by Leonard P. Ayres, vice-president Cleveland Trust Co., is nationally known and represents a reasonable mean of many divergent indices published by other financial agencies. This index shows the percentage each month's business bears to his theoretical normal and is based on the Federal Reserve Index of Industrial Production, but is adjusted for the long-time uptrend. The unadjusted Federal Reserve Index is based on the mean of 1923, 1924 and 1925. Bituminous production levels are closely related to general business levels. This has been shown in Fig. 1, in which actual coal production on a comparable scale has been plotted against the Ayres index of general business activity. *Since there is such a close agreement between the cyclical fluctuations of general business and bituminous production, the Ayers index is used in this study in determining normals for coal.

With general business at a normal level there is no surplus capacity to produce bituminous coal, and thus coal as a fuel has suffered no material loss in recent years. Unequivocal as this statement is, it is an inescapable conclusion one must reach after weighing the facts. While there is no denying past overdevelopment of the coal industry, to assume that this condition still exists is to be blind to the evidence. Data published by the U. S. Bureau of Mines completely refute the theory of present excessive capacity.

These data show that daily capacity of all bituminous mines in the United States in 1924 was approximately 2,875,000 tons. Since this meant a weekly capacity of about 17,000,000 tons, while the maximum weekly requirements rarely exceeded 12,000,000 tons, there was at that time a marked surplus capacity. By 1932, under the stress of economic conditions alone, daily capacity had been reduced to 2,107,000 tons—or a weekly capacity of 12,642,000 tons. When we look back to the 1925–1929 period, in which actual production approached or exceeded the 1932 weekly capacity for many weeks at a time, it is difficult to see how the claim of present-day surplus capacity can be substantiated.

Because of an increasing production rate per unit of labor, however, the number of men employed between 1924 and 1932 declined more rapidly than the capacity to produce. This unit rate was 4.8 tons per man-day in 1924 and 5.2 tons in 1932. Daily capacity in 1934 was 2,013,000 tons—3½ per cent less than in 1932. The number of men employed was 458,011—13 per cent more than in 1932. Production per unit of labor in 1934, however, was only 4.4 tons per man-day—the lowest point in the 11-year period. Much of the indicated decline in output per man-day, of course, was due to shorter hours.

Unfortunately, this does not answer the question of capacity, since the 7-hour day carried with it the 35-hour week. The mine may work six days or multiple shifts and thus increase its weekly capacity, but to do this it must carry extra labor on its payroll. Six full days per week means the employment of 20 per cent more labor than for five days and the rotation of the working force so that one-fifth of the labor is idle each day. The seasonal nature of the industry and the very real responsibility of many producers for the living conditions of their employees make it impracticable for them to burden payrolls with surplus workers to meet a temporary peak demand. The result is that in many instances the producer is limited to five days per week.

It is improbable that reemployment in the industry has exceeded 5 per cent of the men employed in 1934. For practical purposes we can assume that this has happened and that capacity to produce has increased proportionately. We therefore find the industry in 1936 with approximately 480,000 employees, a daily capacity of 2,120,000 tons and a weekly capacity—based upon five full-operation days—of 10,600,000 tons. The experience of last February is something of a check on this estimate; weekly production then reached a maximum of 10,400,000 tons, but many mines were compelled to seek permission from the union to work six days.

Fig. 2 shows the relationship by years between actual mine employment and weekly capacity of all bituminous mines. In addition a line is drawn to represent the mean actual weekly requirements of all consumers in the country for the cold months of 1925, 1928 and 1929, when general business averaged approximately 5 per cent above normal. The lower line, giving requirements during the warm months, is based on the same years. Data for 1926 and 1927 were not used because demand incident to the British coal strike pushed actual coal production in the United States to relatively high figures.

No Surplus in Winter

Even with production capacity at a level estimated for the present, it is evident that, for a period of several years under good business conditions, the national requirements were well in excess of the ability to mine coal for at least six months out of the year. Then when we recall that the country consumed an average of 520,000,000 tons per year between 1924 and 1929, the present annual capacity of 550,000,000 tons does not appear adequate to take care of peak demands.

While a casual inspection of production figures in recent years as compared with tonnages prior to 1930 might lead to the conclusion that the coal industry was losing ground at the rate of 25,000,000 tons per year, nothing is farther from the truth. There are at least two factors which must be considered before annual tonnages can be compared or conclusions drawn from such comparisons. The first is the variable general business; the second is the variation in the fuel value of the coal itself.

As shown in Fig. 1, fluctuations in the level of general business have a direct and proportionate effect upon the level of coal production. In order to eliminate this variable and arrive at figures which will represent "normal" requirements for bituminous coal, with general business at a normal or 100-per-cent level, it is simply necessary to divide actual coal production in a given year by the mean business index for that year. This has been done in column 7 of Table I.

* Since this article was written there has been a slight downward revision in the percentage relationships of the indices for 1930–35 with respect to normal. This does not alter the ultimate conclusions of the author, but tends to postpone the date of recovery to a normal business level and raises the *normal* requirements. This upward revision of coal demands has been incorporated in the body of the text.

The second variable is not quite so simple to eliminate. Theoretically, an average ton of coal contains an unchanging fuel value. Actually the fuel value depends upon (1) the quantity of free impurities contained in the coal as marketed and (2) the comparative efficiency of the burning plant in extracting the inherent heat. In the last twelve years producers have made remarkable strides in their efforts to give the consuming public a fuel free from removable impurities. During the same period technical advances in combustion have enabled the consumer to secure more effective heat from the coal used. While accurate evaluation of the gross percentage improvement in the fuel itself and in its use is impossible, there are certain known indicators which can be used as a workable basis for estimating the relationship between fuel values from 1924 to 1935.

Roughly speaking, 25 per cent of the bituminous coal mined is used by the railroads, 8 per cent by electric utilities, 13 per cent in byproduct plants, 20 per cent by manufacturing plants, 20 per cent by domestic consumers and 14 per cent for miscellaneous uses. The approximate drop in unit consumption between 1924 and 1935 is fairly well established at 15 per cent for the railroads and 35 per cent for the electric utilities. These two classes of consumers account for one-third of the total consumption. It is safe to assume that there have been savings up to as much as 15 per cent in the other two-thirds, with probably 8 per cent as a conservative average. On a weighted basis this means that there has been a saving of 12 per cent in the unit consumption of coal since 1924 or, to put it in different words, the coal of 1924 had only 88 per cent as much value as the coal of 1935. For practical purposes, this increase in fuel value may be considered to have taken place at a uniform rate.

It is now possible to determine the trends in the bituminous coal industry,

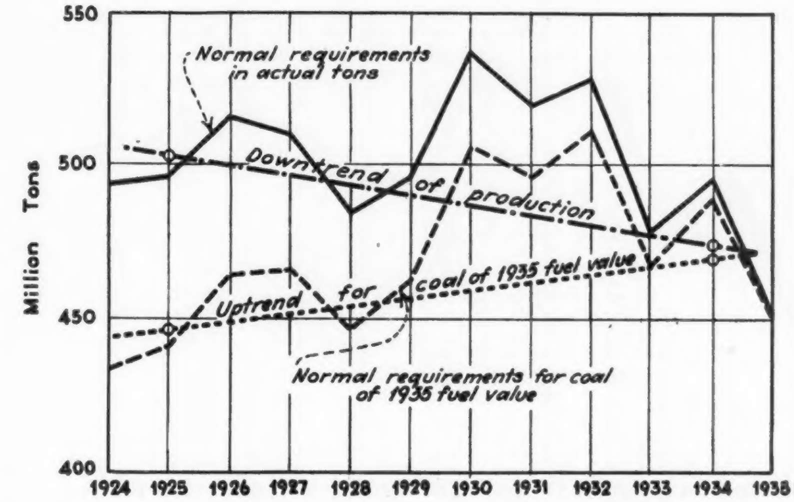
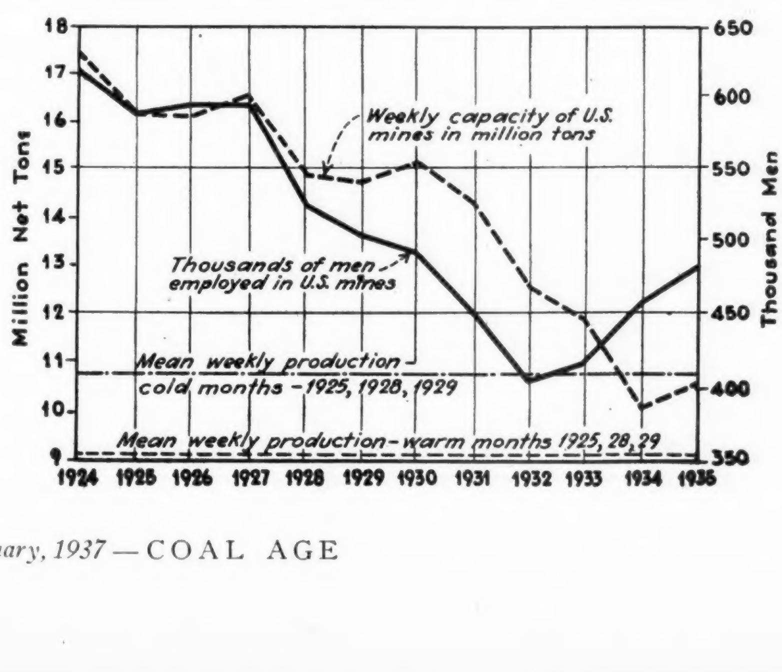


Fig. 3—Production trends vs. effective utilization of coal heat value

first, as to actual production and, second, as to its real use as fuel determined, by the heat derived from it. In order to exaggerate the probable slight downward trend in actual production and at the same time to minimize the uptrend in actual heat yield, the mean annual normals for 1924–1926 are compared with the mean annual normals for 1933–1935. This gives an annual drop in actual production of 2,630,000 tons; at the same time, however, the effective use of coal has increased at the rate of 2,295,000 tons annually. These changes are illustrated in Fig. 3; basic data are given in columns 7 and 9 of Table I.

There has been a definite increase in the use of coal as a heat-producing agent, but this increase has not been sufficient to offset the improved quality of the coal combined with the greater burning efficiency. It is generally agreed, however, that the increase in fuel value per tons used cannot continue at the rapid rate of the last twelve years. Normal requirements for coal, therefore, proably will level off at approximately 500,000,000 tons annually for the next few years and then move upward.

Fig. 2—Relationship between employment, capacity and seasonal demand



While bituminous coal must battle in manv markets with other fuels and energy sources, it is a fallacy to assume that all crude-oil and natural-gas production is competitive with coal. Until economic methods for extracting gasoline and lubricants from coal have been perfected, that part of the crude-oil output that goes into these items should be eliminated in measuring oil's direct competition with coal. Moreover, since approximately 50 per cent of the total natural-gas yield never touches a market that coal can reach, this non-competitive portion also should be eliminated from consideration.

Hydro-electric power competes with coal only to the extent that the gross production of such power replaces power that might have been generated from coal. This replacement must be figured on the basis of the unit production of power per pound of coal at coal-burning plants. Since this unit consumption has steadily declined—35 per cent between 1924 and 1935—the displacement is not so great as frequently advertised. Anthracite, like bituminous coal, today is a much improved product. But, since this coal is largely a domestic fuel, the extent of the improvement probably is not so great and is more difficult to determine. For the purposes of this discussion, it is assumed that the anthracite of 1924 was only 95 per cent as valuable a heat producer as the hard coal of 1935.

Recalculating all actual competition as between different sources of energy with the qualifications mentioned taken into account, we get a picture of the normal requirements for fuel that is at least conservative. The equivalent heat of the different fuels (see Table II) is converted into the number of tons of coal at the 1935 fuel value necessary to replace the competing fuel. For the determination of trends actual fuel consumption has been expressed in terms of normal requirements by the use of Ayres' index.

In the three years 1924 to 1926, average energy requirements of the country

under normal business conditions for which bituminous coal could compete required the 1935 fuel equivalent of 681,706,000 tons. For the 1933–1935 period this requirement reached 777,-344,000 tons. This would indicate that the energy needs of the United States in which coal shares have grown at the rate of 9,563,000 tons of equivalent coal per year. Here is the way this annual growth has been divided:

	Increase*
Bituminous coal	2,294,000 tons
Natural gas	2,408,000 tons
Fuel oil	4,599,000 tons
Hydro-electric power	1,113,000 tons
Anthracite	851,000 tons†
Total	9,563,000 tons

* Annual increase based on 1935 bituminous coal equivalent.
† Decrease.

These figures simply mean that the gains or losses shown for the different fuels could have been absorbed by the given quantity of bituminous coal.

If the average production of bituminous coal by States and months for 1933 to 1935 is assumed to represent the proportion of the national coal business each would enjoy under normal business conditions and if the present daily capacity for each State is estimated on the basis of a 5-per-cent increase over 1934, a picture of the seasonal character of the industry as well as the spread of actual working time (or real competition) can be seen. These comparisons are embodied in Tables III and IV. After all, the percentage of full-time operation that a mine works during a season or year is the measure of its ability to market its coal and, with a reasonable price for its product, becomes the measure of its prosperity.

For the sake of simplicity, the year may be divided into two periods: the cold months (October to March) and the warm months (April to September). In each period there are normally about 130 available working days under the 5-day-week plan now in force. The following table shows the number of working days necessary in each period to produce each State's present proportion of the national tonnage under normal business conditions:

State or Group	Cold Months, Days	Warm Months, Days
Pennsylvania	120.1	102.0
West Virginia	132.3	115.3
Kentucky	124.4	103.7
Virginia, Tennessee and Alabama	126.7	111.7
Maryland	133.2	85.6
Ohio	121.4	89.7
Indiana	136.3	83.0
Illinois	129.6	74.4
All United States mines	127.5	98.0

The lower level of working time in the warm months for the four States in the lower grouping is primarily due to the absence of a market—except for a portion of Ohio's output—via movement on the Great Lakes during the season of navigation. The first three States listed enjoy almost a monopoly on this business. This lake trade, amounting in good years to some 40,-000,000 tons, adds the mean equivalent of 30 working days to Pennsylvania, West Virginia and Kentucky. The lack of this outlet for surplus tonnage during the warm months materially reduces working time elsewhere.

Table I

Year	Daily Capacity of U.S. Mines in 1000 Tons (1)	No. of Men Employed in U.S. Mines (2)	Actual U. S. Production in 1000 Tons (3)	Days Available for Work (4)	Annual Capacity All Mines Full Time in 1000 Tons (5)	U. S. Business Per Cent of Normal Years Index (6)	Normal U.S. Coal Requirements in 1000 Tons (7)	Per Cent Relationship to Coal of 1935 Fuel Value (8)	Normal Requirements for Coal of 1935 Fuel Value in 1000 Tons (9)
1924	2,877	619,597	483,687	308	886,158	98.1	493,055	88.0	433,888
1925	2,685	588,466	520,053	308	826,976	105.0	495,288	89.1	441,302
1926	2,691	593,647	573,367*	308	828,857	106.3	515,867	90.2	465,312
1927	2,735	593,918	517,763	308	842,257	101.5	510,111	91.3	465,731
1928	2,482	522,152	500,745	308	764,428	103.4	484,280	92.4	447,475
1929	2,450	503,993	534,989	308	754,753	108.0	495,360	93.5	463,162
1930	2,507	493,200	467,526	308	772,181	87.4	559,957	94.5	506,479
1931	2,382	450,213	382,089	308	733,735	73.6	519,143	95.6	496,301
1932	2,107	406,380	309,710	308	648,982	58.6	528,515	96.7	511,074
1933	1,988	418,703	333,631	308	612,331	69.8	477,980	97.8	467,464
1934	2,013	458,011	359,368	277	557,597	72.4	496,363	98.9	490,903
1935	2,120†	480,916†	369,324	260	551,200	81.9	450,945	100.0	450,945

* Reduced 25,000,000 tons to calculate column (7) because of surplus exports due to British coal miners' strike.
† Estimated increase over 1934 (latest complete data), 5 per cent.

Table II—Equivalent Tons of 1935 Bituminous Coal Necessary to Replace the Direct Competition of Other Energy Sources Under Normal (100%) Business Conditions.

	THOUSANDS OF TONS OF 1935 VALUE COAL NEEDED TO REPLACE					
Year	All Competing Fuels	Bituminous Coal	Anthracite Coal	Natural Gas	Fuel Oil	Hydro-electric Power
1924	682,667	433,888	88,359	24,733	110,687	25,000
1925	650,997	441,302	58,359*	23,092	103,626	24,618
1926	691,189	465,312	78,893	25,763	94,389	26,832
1927	724,663	465,731	78,626	28,817	122,138	29,351
1928	695,834	447,475	73,282	30,802	112,863	31,412
1929	714,575	463,162	69,046	34,275	119,084	29,008
1930	775,983	506,479	80,534	42,366	114,199	32,405
1931	783,477	496,301	82,481	48,435	121,680	34,580
1932	844,433	511,074	87,023	57,443	142,481	46,412
1933	777,006	467,464	73,092	48,702	149,504	38,244
1934	808,308	490,903	81,603	50,191	150,000	35,611
1935	746,717	450,945	65,657	46,947	147,176	35,992
Mean 1924 to 1926 inc.	681,706	446,834	81,959*	24,529	102,901	25,483
Mean 1933 to 1935 inc.	777,344	469,771	73,451	48,613	148,893	36,616

* 1927 substituted for 1925 because of anthracite coal miners' strike in 1925.

Table III—Mean Monthly Productions by States

(Based on actual production each month, divided by Ayres Index for that month, and averaged for the period 1933, 1934, and 1935)

	1000 NET TONS								
Month	U. S. Total	Penn.	W. Va.	Ky.	Va., Ala., Tenn.	Md.	Ohio	Ind.	Ill.
January	46,170	10,720	11,655	4,695	2,805	240	2,615	2,150	6,145
February	45,315	10,535	11,605	4,815	2,840	231	2,710	2,110	5,985
March	48,065	12,365	12,470	4,880	2,880	242	2,885	2,210	6,160
April	30,785	8,295	8,590	3,415	1,990	138	1,575	1,200	3,125
May	33,800	8,980	10,070	3,665	2,445	123	1,920	1,220	3,055
June	34,400	9,895	9,925	3,665	2,310	134	1,915	1,260	3,145
July	32,350	8,545	9,970	3,595	2,200	126	1,800	1,040	2,890
August	38,715	9,845	11,415	4,460	2,550	167	2,250	1,395	3,665
Sept.	37,550	8,000	10,705	4,520	2,345	168	2,195	1,445	4,280
October	45,500	9,500	12,935	5,070	2,320	213	2,655	1,945	5,640
November	43,515	10,465	11,220	4,595	2,395	198	2,515	1,955	5,350
December	41,315	9,735	9,835	4,040	2,475	208	2,420	2,020	5,805
Total	477,480	116,880	130,395	51,415	29,555	2,188	27,455	19,960	55,245
Present Daily Capacity	2,120	527	526	225	124	10	130	91	271

Table IV—Number of Mine Working Days Necessary to Produce the Mean Normals in Table III

Month	Mean Available Days	U. S. Total	Penn.	W.Va.	Ky.	Va., Ala., Tenn.	Md.	Ohio	Ind.	Ill.
Jan.	22.7	21.8	20.4	22.1	20.4	22.6	24.0	20.1	23.6	22.7
Feb.	20.0	21.4	20.0	22.0	21.4	22.9	23.1	20.8	23.2	22.1
March	22.0	22.7	23.4	23.6	21.7	23.2	24.2	22.2	24.3	22.8
April	21.0	14.5	15.7	16.3	15.2	16.1	13.8	12.1	13.2	11.5
May	23.0	16.0	17.0	19.1	16.3	19.7	12.3	14.8	13.4	11.3
June	21.0	16.2	19.0	18.9	16.3	18.6	13.4	14.8	13.8	11.6
July	21.7	15.3	16.2	19.0	16.0	17.8	12.6	13.8	11.4	10.7
Aug.	22.6	18.3	18.9	21.7	19.8	20.6	16.7	17.3	15.3	13.5
Sept.	20.7	17.7	15.2	20.3	20.1	18.9	16.8	16.9	15.9	15.8
Oct.	22.7	21.5	18.0	24.6	22.5	18.7	21.3	20.4	21.4	20.8
Nov.	21.6	20.6	19.8	21.3	20.4	19.3	19.8	19.3	21.5	19.8
Dec.	21.0	19.5	18.5	18.7	18.0	20.0	20.8	18.6	22.3	21.4
Cold Months	130.0	127.5	120.1	132.3	124.4	126.7	133.2	121.4	136.3	129.6
Warm Months	130.0	98.0	102.0	115.3	103.7	111.7	85.6	89.7	83.0	74.4

POSSIBLE USES

For Coal Visioned by Research

AFTER YEARS of study, the Coal Research Laboratory of the Carnegie Institute of Technology, Pittsburgh, Pa., reported Dec. 3 on the status of its investigations and ventured to suggest ways in which its findings in fundamental coal science might form the background for the development of industries based on coal and for the improvement of present industrial uses and processes into which coal enters. Coking speed and density, their relation to yield, wastes inherent in single-process coking. the ability to forecast quantitatively the effect of changes in design of combustion furnaces all came under discussion; also the possibility of making fillers and softeners for rubber and plastics; of developing new fertilizers, carbons, diesel oils, waxes, resins, paints, varnishes and plastics, lubricants, clay dispersants, esters and tanning agents, and of making benzene by alkalinization. Dr. H. H. Lowry, director, presided.

Quick Coking, High Yield

In the experiments described by W. B. Warren, Coal Research Laboratory, only a small sample of coal was taken because only thus could the coal be subjected to a predetermined reproducible temperature program with either constant or varying heating rates. These rates raised the temperature by increments of from 0.36 to 39.6 deg. F. per minute until a final goal of 1832 deg. F. was reached, with no part of the charge at any time more than 18 deg. F. hotter than any other part. Coal from the Pittsburgh bed in the Edenborn mine, Fayette County, Pennsylvania (a normal coking coal which is coked unblended at the Clairton works of the Carnegie-Illinois Steel Co.) was heated and carbonized at a rate of 1.26, 2.52, 4.86, 9.90, 19.62 and 39.24 deg. F. per minute to 1004, 1292 and 1832 deg. F. Study indicated that yields were proportional to rate of heating. Rates of heating affected yields only at low temperatures or within what is known as the "sensitive range." Above that range the rate of heating modifies hardness and gas composition, but not yields. Rates of heating have less effect as coal rank increases. The sensitive range of Illinois No. 6 coal, Orient No. 1 mine, lies between 572 and 842 deg. F.; that of the Pittsburgh coal mentioned between 392 and 734 deg. F.; whereas Pocahontas No. 3 seam, Pinnacle mine, Algoma, W. Va., had yields so small as to make the determination of sensitive range impossible with present equipment.

Gas composition is greatly affected by rate of heating. Edenborn coal, when the rate was kept constant between 68 and 1292 deg. F., yielded gas with 38 per cent hydrogen if heated at a rate of 2.52 deg. F. per minute and 50 per cent hydrogen if the temperature was raised 39.24 deg. F. per minute.

It seems illogical, added Dr. Warren, to use expensive high-temperature equipment for the entire job of heating coal from atmospheric temperatures to 1832 or even 2192 deg. F. The following may be said in regard to precarbonization at 392 to 752 deg. F.: (1) It saves heat, for most of water leaves at relatively low temperatures instead of at oven temperature as superheated steam; (2) it protects ovens by lowering the moisture in the charge; (3) it shortens coking time a third or more, thus increasing one-third the coke production per oven battery when oxygen content is 6 to 8 per cent on a dry basis and moisture content is 4 to 6 per cent and ovens are charged at 392 to 752 deg. F.; (4) it allows increase in charge per oven unless excessive swelling would make density undesirable; (5) for coking coals having 4 or more per cent of moisture, it decreases liquor 50 to 75 per cent; (6) it makes coke more uniform, possibly improves its quality and probably increases the yield per ton of dry coal; (7) it seems likely that it decreases tar yield and possibly on a percentage basis increases the lighter tar fractions; (8) it possibly decreases the production of ammonia; (9) it leaves gas yield per ton of coal unchanged, but the gas obtained probably will have a higher B.t.u. value per cubic foot; and (10) the process will be better controlled, because the rate of heating and the oxidation of the charge can be more closely regulated.

Combustion phenomena have been studied by the Coal Research Laboratory, declared Dr. M. A. Mayers, to obtain data and calculation methods that can be used to ascertain temperatures, gas compositions, quantities of fuel and of ash and instantaneous combustion rates at any point in a furnace burning solid fuel without actually building the furnace and operating it.

Combustion and gasification reactions group themselves under three partly independent heads which can be considered separately; under appropriate conditions each may determine the overall speed of reaction. The first process is that by which heat is supplied to the fuel to raise it and the oxidizing gas to the temperature at which the fuel will react to the gas at reasonable speed; the second or transport process is that by which the concentration of oxidizing gas at the fuel surface is maintained at a value greater than zero, even though the reacting surfaces are continually removing it and replacing it by reaction products; and the third is that of the heterogeneous chemical reaction at the fuel surface between the solid carbonaceous material of the fuel and the oxidizing gases of the atmosphere at the concentration prevailing within a few "free paths" of the surface. The first two processes are mainly physical; the third is the only true chemical process.

Just what, queried Dr. Mayers, is meant by "ignition"? The reaction rate never becomes zero, although it may reach indefinitely small values. At such very low reaction rates the heat generated by the reaction can be removed from the fuel despite only infinitesimal temperature differences between it and its surroundings; but, as the rate of reaction increases with temperature, a point is reached where the heat released by the reaction becomes sufficiently great to cause the fuel temperature to exceed

(*Turn to page 42*)

NOTES

From Across the Sea

WASHING COAL with dirty water is generally conceded to give a more exact separation of coal from refuse than washing with clean water, because liquids of equal density with coal, other things being equal, give a more exact result, but there is a limit to the quantity of impurity desirable; its type also is a consideration and the degree to which the impurity is deposited on the coal, dulling its luster and causing dustiness when the coal becomes dry.

In a paper read before the Institution of Mining Engineers, L. W. Needham, Mining Department, University of Birmingham, England, declared that it is agreed that the coal is not as well washed if the solid content of circulating water is allowed to become unduly high. One cannot state a limit beyond which solid content becomes undesirable, because conditions vary in different washers, but about 30 per cent has been suggested as a value that normally should not be exceeded. There is, he admits, much divergence of opinion regarding the desirability of washing in clean water or in water containing a controlled percentage of solids.

Solid content in washery water, Mr. Needham explains, can be prevented from increasing in quantity, size and ash content by gravity settlement or filtration or both, or by letting some of the water containing high-ash content solids run to waste. This last method is still used at many washeries.

In gravity settlement, the settling rate must be sufficiently rapid and the settled product must be so low in water content that scrapers, grabs, shovels, etc., can handle it as desired. In a filtration plant, the filtration rate must be rapid enough that the desired capacity can be attained with reasonable size and cost of equipment. The composition of the feed to the plant also should be fairly constant, so that the load on the filtration plant will be reasonably equal. The feed should also be free from constituents likely to corrode or clog the filtering medium and thus shorten its life.

Because solids in many washery waters settle slowly, means must be provided for aggregating them into loose "flocs," so that they will settle more rapidly. Otherwise, settling tanks will have to be uneconomically large or the water obtained from them will be to high in solids. If the refuse associated with the coal contains gritty particles, it will settle freely, but, if it is soft and claylike, it will settle slowly or even refuse to settle.

In the water from fine-coal shakers, particles up to ¼-in. diameter will be found, but usually about 70 per cent of the solids should pass a millimeter (1/25-in.) screen. In the water from slurry shakers (which receive the underflow from cone settling tanks) less than 10 per cent will be above one millimeter and 30 to 40 per cent will pass a 200-mesh screen. Water taken from high levels in a conical settling tank may contain solids 90 per cent of which will pass through a 200-mesh screen.

In flocculation, these small particles have, perhaps, the greatest importance, because they settle very slowly. The expression "semi-colloidal clay" frequently is used to describe the condition of soft clay in washery waters, which is extremely slow in settling. Colloids range from 0.1μ to 1 $m\mu$, or 0.0001 to 0.000001 millimeter, though no such sharp divisions can be made and, even in slowly settling clay, little of this fine material is present.

What governs the behavior of solids in washery water is the percentage present which lies between these colloids and those which are not larger than 0.0025 in., or 0.063 mm. (63μ), and probably are much less. These are the particles loosely termed "semi-colloidal," and they may constitute a relatively large part of the solid matter. The semi-colloids tenaciously coat the coal particles and confer on them also the ability to remain in suspension. Water from the slurry screens contains solids ranging from 15 to 30 per cent ash, according to the quantity of clay present.

Particles of coal and ordinary dirt above 100-mesh will settle with fair rapidity in suspensions containing up to 20 per cent solids but much less rapidly in stronger suspensions because viscosity increases rapidly whenever the solid content exceeds 20 per cent. Unless there are appreciable quantities of clay, a layer of clear water will be obtained in all suspensions, except those which are so concentrated that no further settlement is possible.

But when clay is present the reverse is true. A certain washery water with 25 per cent of solid matter, one-third of which was semi-colloidal clay, was allowed to stand and, though settlement was slow, a layer of clear water was obtained. The same washery water, diluted to one-half and then to one-quarter of the original strength, actually gave no clear water on standing for two days. Most of the solids settled, but the water above them was still sullied by dispersed clay. In the strong suspension, the clay, being near the coal, was adsorbed and carried down with it; in the weaker suspension, the clay escaped and rose toward the top and showed no disposition to fall. When more than 40 per cent of the particles from the slurry-screen underflow will pass a 200-mesh screen, the removal of water by gravity settlement is difficult.

Dedusting, declares Prof. Needham, reduces the quantity of slurry, but after some way shall have been discovered of improving water treatment dedusting may be less necessary. It is unfortunate that a deduster must be used, for a good washer will clean much of the dust thus removed. Slurry-screen water with dedusting will contain (1) a minimum of the 0.25-millimeter to 0 particles originally present in the raw coal, (2) much nearly colloidal clay and (3) particles broken from the coal during washing, the last being much larger than the dispersed clay particles. Fine slurry settled out of such a suspension consists of relatively coarse particles mixed with an excess of fine particles with intermediate fine sizes lacking and a higher water content. This is more easily stirred into suspension again than the fine slurry obtained in the same coal without dedusting. It is therefore more difficult to settle a slurry from a dedusted coal, though smaller in quantity than when the coal was not dedusted. Dedusting, therefore, is likely to complicate water problems.

Magnesium chloride and lime together produce magnesium hydroxide, which acts as a flocculent. Ferric chloride and lime form ferric hydroxide, which flocculates suspended solids. Both of these precipitates at an early stage are colloidal and coat coal and clay particles, uniting coal, clay and any insoluble material into flocs. As most washery waters and clays contain magnesium salts, it is certain that the adsorption of precipitates in this way causes flocculation with lime, but the make-up water does not contain enough of these salts, and the addition of magnesium chlorides almost certainly would be too costly.

Clay flocculates apparently by the adsorption of ions of opposite charge to ions on the colloidal or near-colloidal clay particles, making flocs that no longer will stay in suspension, but the hydroxides have little flocculating effect on coarser coal and refuse, although some action occurs. Large particles, however, are entangled in the flocs as they settle and travel down with them. They take little direct part, however, in the flocculation.

Preparations containing potato starch, also gelatin and various glues, are excellent flocculents for suspended solids. Starch solutions usually are employed under slightly alkaline conditions, lime being the preferred alkalinizer. These solutions, under the best conditions, give more complete and striking action than the electrolytes described and have a different manner of action.

A few drops of 0.5 to 1.0 per cent of potato-starch solution, made by adding the starch as a paste in cold water to boiling water and continuing the boiling for 2 to 3 minutes, caused coal particles up to 20- to 24-mesh Tyler (0.83 to 0.70 millimeters) to stick together, as could be seen when the particles were placed in a flat glass dish and covered with distilled water. The starch solution was added from a burette, and the dish rocked a little so that the particles collided. With smaller particles the effect is striking. Coal particles were literally stuck together by the starch.

Unless too much starch is added, the particles will absorb it almost in proportion to the starch present, but only at their edges and corners. To make an even spread all over the particles was almost impossible. It was evident that the starch solutions would attach themselves not only to colloidal and semi-colloidal particles but also to those of larger size.

Note that starch solution is added to the suspension. If coal particles are added to a starch solution dispersed in water in quantity such as with the contrary procedure would give good results, the flocculation is relatively unsuccessful. When a drop of starch solution is added to an excess of water and the mixture is slightly

shaken, the starch solution segregates into jelly masses which can be seen under the microscope. They will attach themselves to coal particles where available. The jellylike bodies do not tend to cohere but rather to disperse, especially if shaken.

It has been found that: (1) A 1-per-cent starch solution will flocculate particles between 14- and 16-mesh Tyler (1.17 to 0.99 millimeter) and also smaller particles, but with decreased effectiveness, in the region of 60- to 65-mesh. For the latter fraction, the flocculation is slower and less complete. (2) A 0.1-per-cent starch solution will flocculate particles between 35- and 48-mesh screens (0.417 to 0.295 millimeter) and decreases in effectiveness in the region of 200-mesh (0.074 millimeter). (3) An alkaline starch solution will not flocculate coal particles bigger than 200-mesh to any appreciable extent, but flocculates much smaller particles more readily.

Evidently, a jellylike mass serves better for coarse particles and a moderately dispersed medium for small particles, and a well-dispersed medium for the smallest particles. If the clay is flocculated cautiously with lime or other electrolyte and then treated with starch at or near the iso-electric point, the addition of starch produces good flocculation. The lime generates small flocs, which the starch sticks together. The most rapid flocculation of dispersed clay is obtained with preparations of alkaline starch in the presence of free alkali, forming light, bulky flocs. Clay suspensions also can be flocculated by acids, and these flocs also further flocculated by starch, giving a result similar to that obtained under alkaline conditions. Hydroxide flocculation can be satisfactorily applied in addition to that of starch with a slight increase in the effectiveness of the latter.

R. Dawson Hall

On the ENGINEER'S BOOK SHELF

Requests for U. S. Bureau of Mines publications should be sent to Superintendent of Documents, Government Printing Office, Washington, D. C., accompanied by cash or money order; stamps and personal checks not accepted. Where no price is appended in the notice of a publication of the U. S. Bureau of Mines, application should be directed to that Bureau. Orders for other books and pamphlets reviewed in this department should be addressed to the individual publishers, as shown, whose name and address in each case is in the review notice.

Coal, Its Constitution and Uses, by W. A. Bone and G. W. Himus. Longmans, Green & Co., Ltd., New York. 630 pp. Price, $750.

This important compilation on the scientific uses of coal embodies the practical experience of the authors, the senior contributor of which is the dean of British fuel technologists. The material is up to date and compact with the economic, technical and chemical branches of the art of fuel technology. Though primarily intended for the British specialist and covering appliances and operations of little interest here, and though the economic aspects of the subject relate peculiarly to British problems and have only remote interest to the American reader, enough of American practice is included to interest the American fuel technologist and chemical engineer.

Sections of the fuel problem are of importance to the American technologist, however, and these are handled with consummate skill and clarity. Such, for instance, are hydrogenation of coal for the production of motor and lubricating oils, which is discussed and fully explained, with examples freely drawn from practice. Hydrogenation is a rational method of conserving oil, a subject of growing importance to the United States, as America is the world's largest repository of coal, with oil complementary to it and in need of conservation.

The authors explain much of their own work and that of other authorities on the controlled oxidation of coal, and develop a partial explanation of the structure of coal and allied fuels. In the last decade, much work has been done in this field, and the results need the codification here presented. Several chapters packed with information on the uses of pulverized coal, smoke abatement, domestic heating and fuel economy—to name a few of the items—are elucidated by tables and illustrations.

Surface combustion is still green and awaiting development, and Prof. Bone describes his own work in this field and recent developments by others. There is much inspiration in this phase of combustion of fuel gases, for it may lead in the future to novel departures from what is now orthodox practice in furnace design. —E. S. Sinkinson.

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Preventing Accidents by the Proper Use of Permissible Explosives, by D. Harrington and S. P. Howell, U. S. Bureau of Mines, Technical Paper No. 567, 43 pp.; paper. Price, 10c.

Black blasting powder gives a flame that lasts about 4,500 times as long as that of permissible explosives. The flame of the former actually flares only about $1\frac{1}{2}$ seconds, but in that length of time it does much damage. The volume of flame of blasting powder also is far greater than that of permissibles. Black blasting powder, moreover, gives a somewhat hotter flame than ammonia dynamites or permissibles, though a somewhat cooler flame than blasting gelatin or gelatin dynamites.

Fifteen grams is the largest quantity of granular black blasting powder which can be fired without igniting a flammable mixture of dust, firedamp and air, but 680 grams ($1\frac{1}{2}$ lb.) is the limit of permissible explosives that can thus be fired. The relation is 1:45. For these reasons, set forth in the booklet in greater detail, the authors urge that permissible explosives be used in every coal mine in which there is any chance whatever of gas or dust ignition, and then, in reference to sensitiveness to sparks and flames, they proceed to widen the application to all coal mines.

All explosives, however, the authors declare, are so sensitive that they never should be tamped vigorously and with any other than a wood tamping bar. The copper-tipped article, formerly favored by safety experts, is ruled unsafe and impermissible. It is stated also that the paper wrapper of the primer cartridge should not be cut or broken except to insert the primer, and the capsule of the electric blasting cap should be secured in the axial line of the outer end of the last cartridge to be placed in the hole.

If any divided length of cartridge is to be used, this section should be the first explosive to be placed in the hole, because, having been cut and thus exposed to the air, it probably is more insensitive to detonation than the undivided cartridge and therefore should be placed where it will not be required to carry forward the detonation to other cartridges. Should it fail to detonate, it alone will burn or fail to explode and not it and all the full-length cartridges between it and the end of the hole.

Other valuable facts and suggestions are given and statistics verifying some of the statements made. One suggestion is that, where a borehole approaches, within normal stemming length, an opening in the coal such as the side of a room or entry, it should be holed clear through and then carefully stemmed at each end; the explosive should be placed in the center of the hole. Such a hole may blow forward or backward if not well stemmed.

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Steinkohle (Bituminous Coal and Anthracite), by Ernst-George Lange. Biographisces Institut A.G., Leipzig, Germany. 155 pp., $6\frac{1}{4}$x9 in.; paper. Price, $328.

This publication is Part 4 of the series entitled "Changes in International Economics, edited by Hermann Schumacher. Various chapters deal with evolution of international coal economics and commerce, changes in coal production since the War, development of the substitutes for coal, evolution of coal traffic with principal coal exporting and importing countries, including freight problems and international regulation of coal commerce.

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Electrical Viewpoint in a Complete Safety Survey of a Coal Mine, by E. J. Gleim, U. S. Bureau of Mines. I. C. 6894. 18 pp., 8x$10\frac{1}{2}$ in.; mimeograph; paper.

This Information Circular contains practical suggestions enabling management and electrical engineers to study their electrical installations from the standpoint of safety. Little is said as to permissible machinery. However, this reference may be quoted: "Use of gaskets in an effort to secure flametight joints is not a reliable substitute for the wide, accurately machined joints of the permissible machine; nor can other makeshifts be depended upon to take the place of safeguards such as strong castings, which are proved by explosion tests in the permissible machine."

OPERATING IDEAS

From Production, Electrical and Mechanical Men

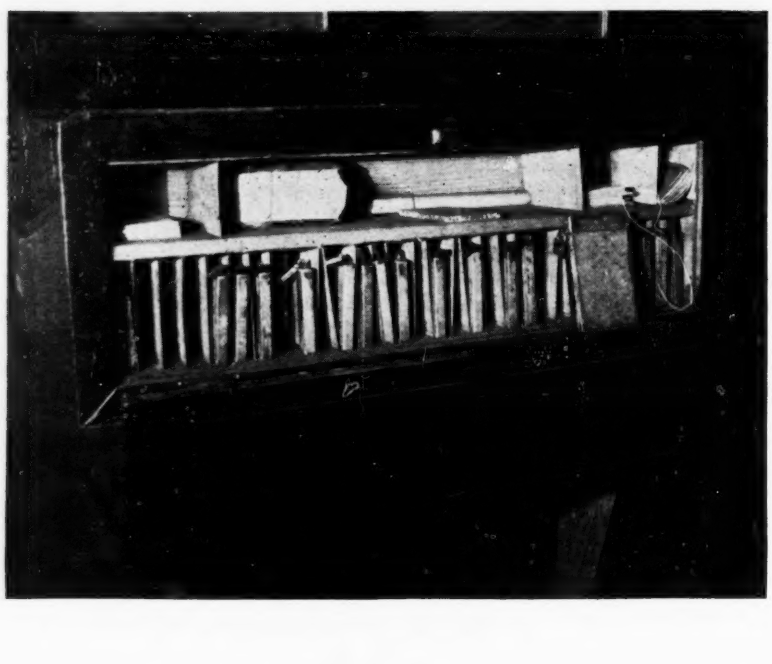
Locked Metal Cases Protect Underground Time Books

Providing individual sheet-metal cases for time books used in the New Orient mine of the Chicago, Wilmington & Franklin Coal Co., West Frankfort, Ill., was the answer to a problem of how to keep the time books reasonably clean, save them from mechanical injury and prevent tampering. About 35 of the books are in daily use inside the mine and in the morning of each working day are carried to the sections by the foremen and in the afternoon are sent out on a haulage locomotive to the timekeeper who works in the mine manager's office on the main bottom.

The illustration shows a number of the metal cases containing time books. They are stored in pigeonholes in a special wooden cabinet fastened to a wall in the underground office. The cases are made of galvanized steel. Corners are soldered and the top is hinged at one end and fitted with a padlock hasp at the other end. Inside dimensions are close to the dimensions of the book but are ample so that the book will slide in and out by its own weight.

One of these steel cases, which is kept in the office as a matter of interest, attests to the need for mechanical protection for the books and also to the efficiency of the method adopted. This case, with a book inside it, was damaged by heavy equipment, but the book itself was not rendered useless nor illegible.

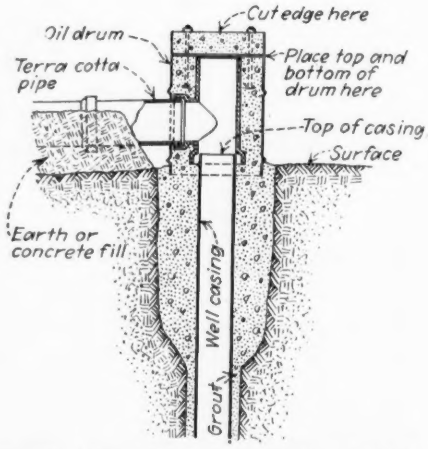
During the off-shift the time books in their padlocked steel cases are stored in a pigeonhole cabinet in the underground office



Oil Drum Facilitates Borehole Protection

When mine water is discharged through a borehole to the surface, the upper end of the borehole should be protected so that rocks or other objects cannot fall or be thrown into the pipe and obstruct the flow of water from the pump. The accompanying sketch shows an inexpensive and efficient protective covering devised by the Reitz Coal Co., Windber, Pa., and reported by I. H. Frailey, mining engineer.

After carefully filling the space between the casing and the wall of the borehole with cement grout a terra cotta tee of the proper diameter is placed on the end of the casing. Several lengths of terra cotta pipe are connected to this tee. A steel oil drum is cut in two about 6 in. from one end and the largest section is placed around the tee and the space filled with concrete. The 6-in. section filled with concrete forms the cap, which is securely fastened on with two anchor bolts. These bolts permit removal if necessary.



Details of method of protecting borehole discharge

By installing a terra cotta tee and pipe of greater diameter than the casing, friction is reduced, and by using several lengths of pipe for the horizontal discharge line, deliberate insertion of foreign matter that might clog the hole is prevented. Also, a weir may be placed across the end of the discharge line to check the flow of water from time to time. The steel oil drum makes a good form for the concrete. The end of the larger section is removed to facilitate pouring the concrete, but the head of the 6-in. section is left intact and a neat joint is formed by placing the two uncut ends of the drum together.

The borehole casing for 3 ft. or more below the surface is provided by a thicker wall of concrete as a protection against freezing and consequent disintegration, which would result, in case a thinner wall were adopted, in pieces of rock and concrete falling into the hole, as the acid in the mine water will in time destroy the steel casing, after which the grouting and concrete must form the lining.

Working Hints From a Shopman's Notebook; Reclaiming Clutch Flanges

By WALTER BAUM

*Master Mechanic, Perry Coal Co.
O'Fallon, Ill.*

RECLAIMING the clutch flange, No. 1941, for the rear-corner drive of the Joy 5BU loader can be done as hereinafter described. The flange fits shaft No. 1636 and is keyed on. Damage occurs to the hub by the key shearing off while the shaft continues to turn. To repair the damage, the hub was bored out just enough to clean up the roughness in the hub and a bushing was made with a press fit. Before pressing the bushing in place, the key remaining in the hub was marked on the surface of the flange so that it could be located after the bushing was pressed in and bronze-welded to the flange. When cool, the bushing was bored to fit Shaft No. 1636. Then the keyway in the bushing was cut by using the mark made to show the location of the original key and cutting the bushing on each side of it.

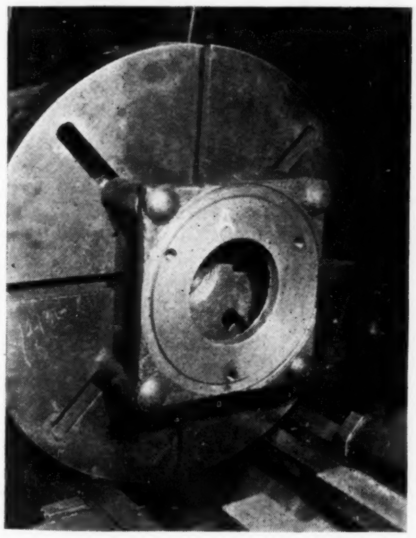


Fig. 1—Holder after facing, machining of shoulder and removal of plug bolts

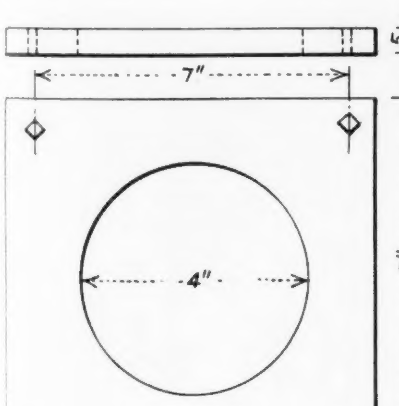


Fig. 2—Details of holder

In order to repair the damaged flange and rebore it is as truly as possible, I made a holder of a 5/8x8x8-in. steel plate. A 4-in. hole was cut in the center and 5/8-in. holes were drilled in each corner. The 5/8-in. holes then were punched out square to accommodate the carriage bolts. Using spacers of 1-in. pipe $2\frac{1}{8}$ in. long, the plate was bolted to the faceplate on the lathe and a circle of the same diameter as the six holes in the flange was marked on it. The circle was then divided into three pairs of equal arcs, after which the faceplate with the other plate bolted to it was removed for drilling three 13/32-in. holes in the steel plate (Fig. 1). These three holes were tapped with a $\frac{1}{2}$-in. USS tap and the faceplate was put back on the lathe, whereupon the three holes were plugged with $\frac{1}{2}$-in. bolts with the heads of the bolts on the side of the steel plate next to the faceplate and the ends of the bolts just flush with the other side of the steel plate. The steel plate then was faced off true, after which a small shoulder (Fig. 1) to match the shoulder on the flange was machined on the plate. Fig. 3 shows the flange *B* bolted in place ready to be bored out. The flange can be removed after the boring is done and replaced without danger of not getting it back true for boring the bushing. I reclaimed four of these flanges with one set-up. After the steel plate, *A*, is removed from the faceplate it must be refaced and a new shoulder cut on it before reuse.

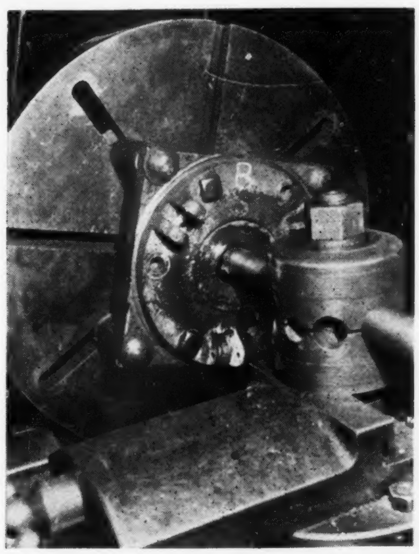


Fig. 3—Flange bolted to holder ready for boring out bushing

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New Year

• With this issue of Coal Age, the Operating Ideas department begins another twelve months' period of service to operating, electrical, mechanical and safety men at anthracite and bituminous mines. The content in the coming year will reflect advances in practice as they occur and, of course, will incorporate the latest developments of the men responsible for seeing that the coal is gotten to the railroad car at the lowest possible cost. As always, this department will endeavor to present selected cost-cutting or efficiency-promoting ideas, and to do this solicits your help. If you have originated such an idea, send it in, together with a sketch or photograph if it will help to make it clearer. For each acceptable idea, Coal Age will pay the author $5 or more.

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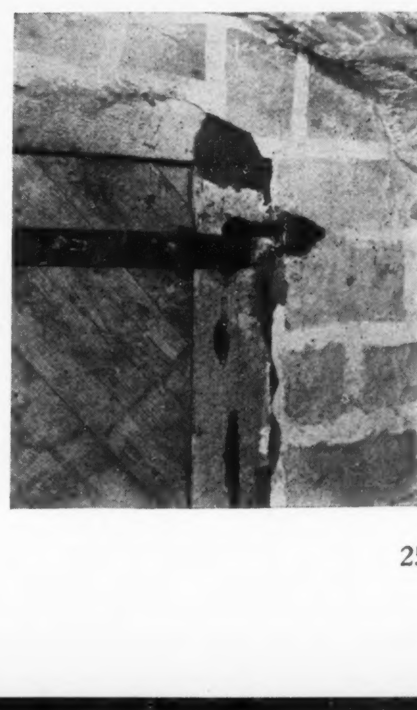
Anchor Prevents Turning Of Hinge Pin

Hinge pins on mine doors at Stirrat No. 19 mine, West Virginia Coal & Coke Corporation, are secured permanently against turning by an eyebolt which anchors the top end of the pin to a strap fastened to the back side of the post. Other means, such as a square nut welded to the pin and set into a square countersink, proved satisfactory for a while, but ultimately the wood gave way slightly and the pin turned, letting the door sag and foul on the rail.

The hinge shown in the illustration is on a standard door in 2d North, Steele Mains. Both the pin and the eyebolt are made of $\frac{3}{4}$-in. round stock. With this construction, used at the mine four years, only extreme decay of the door post can result in the pin turning out of plumb.

The eyebolt permanently holds the hinge pin plumb



Mine Switch Signals Use Standard Railway Box

To attain safety and speed in underground haulage it is necessary to equip the track switches with lamps to indicate accurately whether or not the switch points are tight against the rail or at least close enough to eliminate chance of derailment. The contact-making mechanism should be of rigid construction with independent adjustments for the two positions and the protecting case should be rugged and waterproof. At New Orient mine of the Chicago, Wilmington & Franklin Coal Co., West Frankfort, Ill., after experiments with shop-made contact mechanisms and a trial of a factory-made switch box of standard design for steam and electric railroads, it was found best to standardize on the latter.

At this time eight of the main-line switches in the mine are operating with indicators controlled by these boxes—built for surface railroad use. They were made by the Union Switch & Signal Co. and are known as the "standard switch box with top and bottom contacts."

Cable Reels Are Housed For Greater Efficiency

Locomotives serving mobile loading machines cannot be petted. They must stand the gaff of a pace which assures the minimum of delays in changing cars behind the machine. That this service may require an alteration in locomotive design is illustrated by a difficulty which has been overcome at the Omar No. 5 mine of the West Virginia Coal & Coke Corporation, Omar, W. Va. Here it became necessary to house the cable reels to speed the work and eliminate maintenance difficulties brought on by the new service.

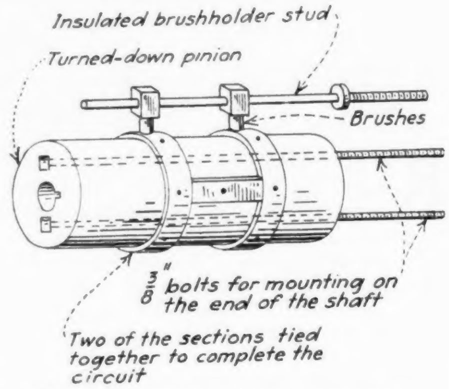
The trouble was due to the loading machine throwing coal onto the end of the locomotive, thus tangling the trailing cable and stopping the reel. To load the head end of the car to capacity means that some coal is sure to spill and there is a time advantage in not having to be careful in spotting. The new covers save the reel from damage by this coal and also afford a measure of protection for the brakeman.

As shown by the illustrations, the cover is hinged at the closed end, thus providing convenient access for inspection. Construction is based on the use of $\frac{3}{16}$-in. plate fabricated by arc welding. The locomotives are Jeffrey 6-ton Type MH88 units, which have been rebuilt to incorporate ground potential control and other improvements.

Blinker Switch

Experience with elevator-door switches as a means of operating blinker lights and thus indicating whether or not conveyors were in operation has led R. F. Good, Lykens, Pa., to develop the switch described below. About nine years ago, Mr. Good remarks, he installed a commercial-type door switch on a conveyor so that it would operate a blinker light and show whether the conveyor was running. The conveyor speed was such that the light blinked once about every 5 seconds, and the switch operated as much as a year at a time without giving trouble. Later, two switches were installed on screw-type dust conveyors operating fast enough to cause the lights, located about 400 ft. from the switches, to blink about once a second. Higher speed and the increased exposure to dust, however, made it necessary to give attention to the switches every three or four weeks. Inprovements were made from time to time, which helped matters to some extent, but eventually a decision was made to develop a switch better adapted to the service.

In building the new switch a drum was made by turning down the teeth of an old micarta pinion. Four old controller bars were bolted to this drum so that they would form two rings around it. Additional equipment included an old brush holder, brush-holder stud and brushes to fit. The drum then was bolted to the end of the screw-conveyor shaft and the brushes were mounted so that they would ride on the rings on the drum.



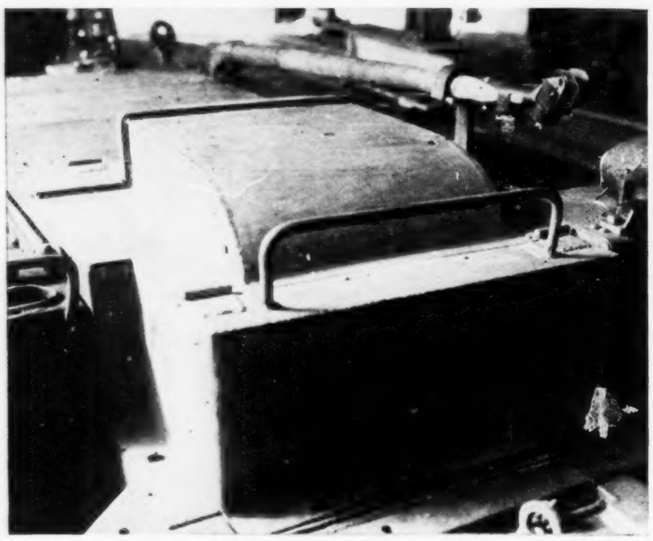
Details of blinker-switch construction

The rings are not continuous around the drum, as they are installed with gaps of about 3/32 in. between sections to give the blinking effect. A tie between one section in each ring was inserted to complete the circuit to the lamp, which is lit for one-half a revolution and dark the other half. The first of these switches went into service the first of September, and the rings are just now beginning to take on a polish.

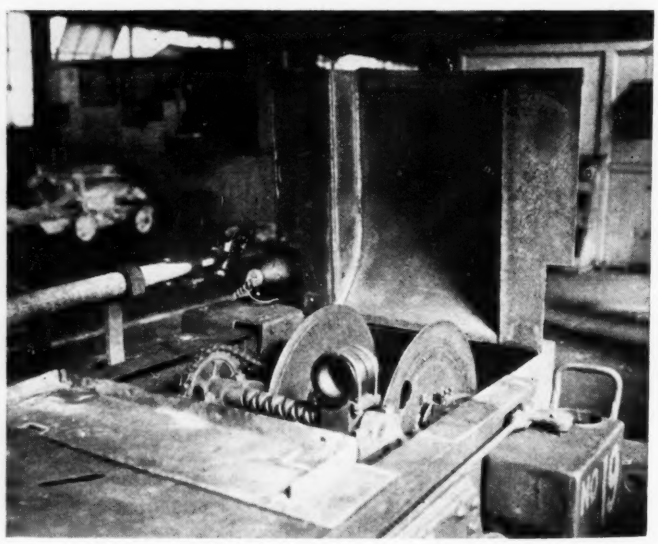
Stirrups Hold Ties Over Ditch

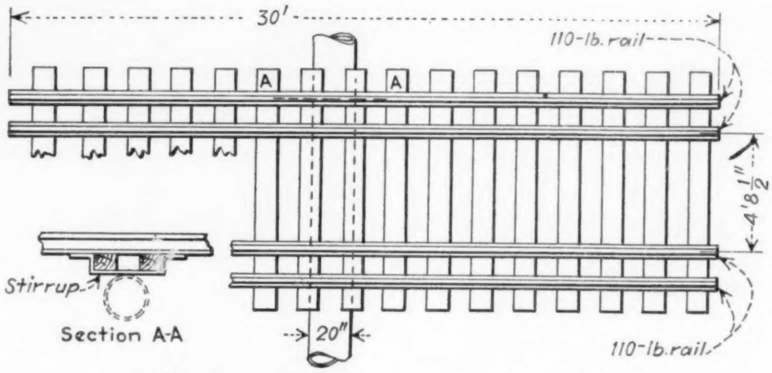
When provisions had to be made to put 20-in. wood pipes under the railroad for the discharge of water from the Kehoe-Berge Coal Co.'s mines at No. 10 Tunnel, Duryea, Pa., after the flood which drowned out those mines and others adjacent, the Lehigh Valley R.R. affixed two 110-lb. rails to the ties on either side of the regular rails. Stirrups were welded on the under side of the new rails, and these were passed under the ties to hold them

The reel is protected from coal and the locomotive is made safer for the brakeman



Hinged cover raised for inspection of the reel on locomotive protected against spillage





Bridging a track over a pipe without weighting it

up and support the running rail and at the same time relieve the pipes of any load. This method of sustaining track over the filled ground of a ditch or over a pipe makes an easy manner of meeting what is often a perplexing problem in the laying of mine or railroad tracks.

Inspection Dates Posted On Bulletin Board

On a wall in the shop at the Omar No. 4 mine of the West Virginia Coal & Coke Corporation hangs a spacious bulletin board on which the day of the week or the month on which each individual cutting machine and mine locomotive is scheduled for a thorough shop inspection is posted in large letters. The shop adjoins the lamp house, and therefore a machine man, as he passes by to work, needs only to glance inside to refresh his memory as to the date when his machine must be brought to the shop for the regular inspection.

Haulage equipment consists of Goodman 13-ton main-line and Jeffrey 6-ton cable-reel locomotives. Cutting machines are of the Jeffrey 29B arcwall type. All machines and locomotives are many years old but have been rebuilt to incorporate every available improvement to raise operating efficiency and reduce maintenance cost. The main-haulage locomotives, being of prime importance, are inspected every other night. Gathering locomotives are inspected once a week and cutting machines once a month.

This board carries locomotive and machine serial numbers and their inspection dates

Compressed-Air Engine Effects Savings

Some months back, the use of compressed air at No. 12 colliery of the Dominion Coal Co., New Waterford, N. S., came under question. A compressed-air engine was driving a 24-in. flight conveyor handling the coal from a dipping longwall face which served as the main slope. It was known to be an "air eater," so a test was made as to its actual consumption of air, states M. W. Booth, steam engineer, Dominion Steel & Coal Corporation, Sydney, N. S., in describing revisions to increase efficiency.

Test with a flow-meter test showed that the engine used an average of 1,730 cu.ft. of air per minute. It was thought to be developing about 25 to 30 hp., but at that time the exact power output could not be determined. Such a costly power source seemed undesirable, and proposals were made for electrification with a 75-hp. motor, as electrically driven haulage hoists and pumps were installed in the mine except in the end of the main slope longwall, where this flight conveyor was working. An oversize motor was suggested, because motors should not be too small for the work they have to accomplish.

To install this motor on the flight conveyor, two reduction gears would have had to be provided, in addition to a heavy baseplate and flexible coupling, and to accommodate these would have required much brushing at the head of the conveyor. The flight conveyor was to work on the dip longwall for about two months, when it would have to be transported with all its electrical equipment to a new dip longwall, where again the site would have to be brushed. Cable of sufficient length to connect with the present terminal, a transformer circuit breaker and a liquid control gear would be required because, to promote safe operation in these mines, all motors from 75 hp. up have to be supplied with liquid control. It was ascertained that this installation would cost $10,000.

Consideration was given to the installation of a 50-hp. compressed-air engine of the Holman Vee type with a chain drive to connect with the existing conveyor shaft. Before the engine arrived, the drive end of the conveyor was taken to the shop, and by brake test it was found that 1,730 cu.ft. of air per minute developed 22 hp. in the old engine.

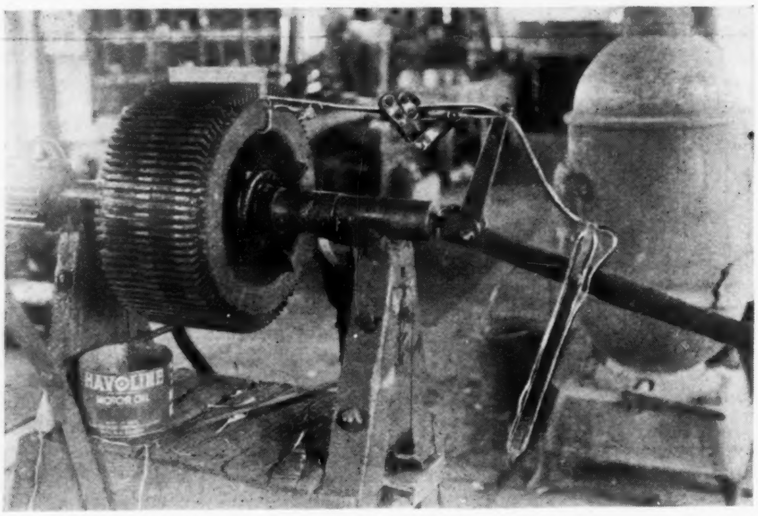
When the new engine arrived and was installed, a muffler was supplied, and the installation gave satisfaction from the time of its installation as to speed, load carried and capacity. A flow-meter test later showed that the engine was using 430 cu.ft. of air per minute, as against 1,730 cu.ft. with the former engine, yet the engine, installed complete, cost only $1,200, giving a simple, flexible, light, compact installation, easy to transfer from place to place in the mine as required, easy to couple and costing only one-tenth of an electrical installation, to say nothing of the room the latter would have needed, its lack of flexibility and other drawbacks.

Wires Tightened With Ease Using Special Puller

To do a first class job of winding a ring-wound armature it is necessary to pull the wires tight. To accomplish this objective with ease, dispatch and efficiency the Sahara Coal Co., at its Harrisburg (Ill.) central shops, uses the puller illustrated below. Here it is seen as set up for winding the armature of a Morgan-Gardner locomotive.

The fulcrum block is fastened to the end of the armature shaft by means of a threaded stud, and the Buffalo wire grip which forms a part of the device is copper lined. The threaded hole in the end of the shaft, which represents a design change made by the coal company, is used also for supporting the armature when it is being dipped in insulating compound.

Every third turn the puller clamp is attached to the wire and brought into play to tighten it. This is far more effective



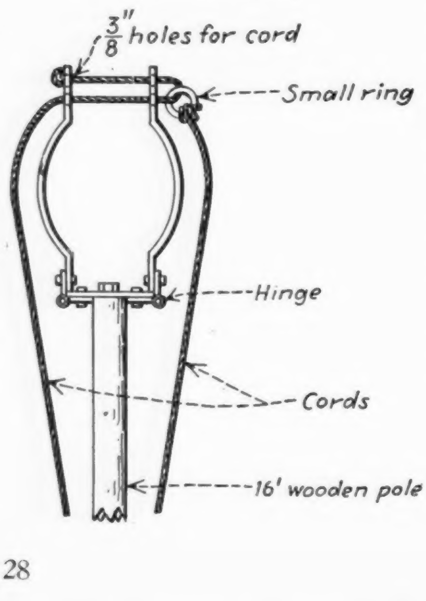
No trouble to pull the wire as much as it will stand

than the older method of jerking the wire by hand upon the completion of each turn. The device is typical of the efficient maintenance methods devised and used by the electrical department.

Device Facilitates Replacing Light Globes

To permit replacing burned-out light globes without climbing the poles, Joseph Testen, foreman, Boston Run colliery, Philadelphia & Reading Coal & Iron Co., Mahanoy City, Pa., has developed the equipment shown in the accompanying illustration. The lights are carried on arms 20 ft. above the ground. By standing on the ground and manipulating the cords the tongs may be clamped around a burned-out bulb to unscrew it. Then, by reversing the process, a new bulb may be inserted in the fixture. One cord is used to tighten the tongs and the other, with ring, is used to loosen the device after the new bulb is in place.

Details of device for replacing burned-out bulbs



Overcast Valve With Contact Warns If Pressure Drops

Failure of either fan or leaving a main door open results in a signal being transmitted immediately to the haulage dispatcher in the mine of the Boone County Coal Corporation, Sharples, W. Va. This was made possible by installing a pressure-operated contactor in an overcast on the main haulway approximately 100 ft. from the underground office of the transportation dispatcher.

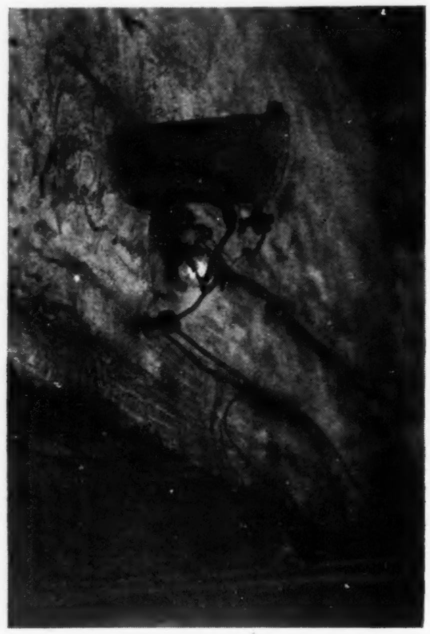
Development of this installation grew out of the need for a signal to be actuated by air flow or pressure in addition to the remote automatic control signal lamps which notify the shop force if the motors of either fan should stop. The pressure or air-flow signal would take care of the possibility of a drive-connection failure or a damaged fan.

Instead of the conventional and far more costly method of installing pressure or air-flow contactors at each fan and carrying signal lines to the dispatcher's office, C. B. Locke, electrical engineer, hit upon the idea of the pressure-operated contactor in the overcast.

Fans operate exhausting and the pressure in the overcast is negative with respect to that in the haulway beneath. The device consists of a 4-in. pipe with a top-hinged disk hanging over the open end which is cut at an angle so that gravity tends to swing the disk away from the pipe. A contact at the bottom of the disk is closed when normal suction holds the disk against the end of the pipe.

When the pipe was cemented into the overcast it was adjusted to the exact angle to make the device sensitive to opening of a main door or failure of either fan. When any one of these events occurs, two lamps in series on trolley voltage, one at the overcast and the other over the dispatcher's desk, go out. By observing the blinking of his lamp the dispatcher may note the progress of a trip through the doors.

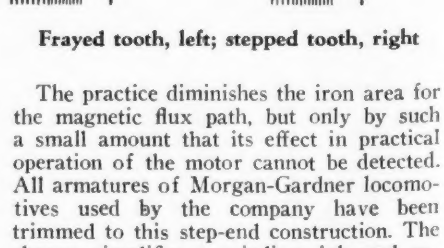
A prolonged outage of the lamps calls for examination of the doors and perhaps telephoning the outside to send inspectors to the fans. Noting the blinking of the lamp on the overcast, the mine crews have learned that a door kept open too long will be detected immediately and so are inclined to be more careful. A dispatcher is on duty day and night.



The lamp under the pipe is lighted, thus indicating that the mine doors are closed and both fans are operating properly

Old Armatures Improved By Trimming Teeth

To eliminate difficulties from bent and expanded lamination teeth on old type armatures which have plain end disks without tooth supports it is practicable to trim the last three or four laminations to form vertical steps at the ends. The Sahara Coal Co. follows this practice in its central repair shop at Harrisburg, Ill.



Frayed tooth, left; stepped tooth, right

The practice diminishes the iron area for the magnetic flux path, but only by such a small amount that its effect in practical operation of the motor cannot be detected. All armatures of Morgan-Gardner locomotives used by the company have been trimmed to this step-end construction. The change simplifies a winding job and results in securing better insulation of the coils at the tooth corners.

WORD FROM THE FIELD

I.C.C. Denies Carriers' Plea For Surcharge Extension

The Interstate Commerce Commission rejected by a 9 to 2 decision on Dec. 19 the plea of the railroads that emergency freight surcharges, scheduled to expire Dec. 31, be continued until 60 days after the Commission's decision on a proposed general freight-rate adjustment (*Coal Age*, December, 1936, p. 595). Chairman Mahaffie and Commissioner McManamy dissented. Although coal interests protested vigorously against the proposed extension, there was no mention of coal in the ruling. It was emphasized, however, that the present conclusions "are wholly without prejudice" to any future rate decisions. Hearings on the proposal for a general readjustment will start on Jan. 6.

The majority opinion was that the emergency which the Commission undertook to meet in its original decision in March, 1935, no longer exists. "A continuing revival of industry," it added, "appears likely to result in a further increase in traffic, and no sharp general increase in operating expenses is immediately in prospect. Shippers and receivers of freight have every reason to expect the elimination of the emergency charges at the end of this year, and an extension, in the light of our previous expressions under existing conditions, they express the opinion, would amount almost to a breach of faith."

In his dissenting opinion, Chairman Mahaffie declared that the emergency rates had not placed any hardship on business and were helping the roads. Commissioner McManamy asserted that decreasing the carriers' revenues pending consideration of permanent rate adjustments would have a far more serious effect on industry in general and the railroads in particular than the continuation of emergency charges pending the outcomes of a ruling on permanent rate increases.

New Preparation Facilities

HEISLEY COAL CO., Nanty-Glo, Pa.: contract closed with Roberts & Schaefer Co. for Stump Air-Flow cleaning addition to existing plant; capacity, 50 tons ¾x0-in. coal per hour; completed.

HOWARD COLLIERIES, Williamson, W. Va.: contract closed with Roberts & Schaefer Co. for Marcus picking-table screen and equipment for tipple to prepare four sizes; capacity, 300 tons of mine-run per hour.

LESLIE LARSEN & Co., strip mine near Madisonville, Ky.: contract closed with Morrow Mfg. Co. for six-track tipple preparing six grades of coal, the equipment to consist of reciprocating plate feeder, apron conveyor, shaking screens, vibrating screens and loading booms; capacity, 175 tons of mine-run per hour; probable date of completion, Jan. 1.

PEERLESS COAL & COKE CO., Vivian, W. Va.: contract closed with Roberts & Schaefer Co. for Menzies Hydro-separator cleaner and equipment; capacity, 85 tons of ½x2½-in. coal per hour.

PHILADELPHIA READING COAL & IRON Co., St. Nicholas central breaker, St. Nicholas, Pa.: contract closed with Wilmot Engineering Co. for one 9-ft. Wilmot Improved type Hydrotator with conveyor line and automatic float to prepare approximately 100 tons per hour of No. 4 buckwheat; installation represents replacement of an old-style Hydrotator.

UNION COLLIERY CO., Dowell, Ill.: contract closed with Roberts & Schaefer Co. for dry-cleaning plant for air-cleaning 2x0-in. coal with Stump Air-Flow units; capacity, 50 tons per hour; completed.

Pancoast Colliery Leased

The Pancoast colliery, at Throop, Pa., formerly operated by the Price-Pancoast Coal Co., has been leased by the Throop Mining Co., which will reopen it as soon as it can be put in condition for operation. The Throop company, which was recently organized, has these officers: Charles Jerso, Pittston, president; Angelo Falzone, Pittston, secretary, and Biageo Warnerio, Throop, treasurer. The Pancoast colliery, which was opened in 1881, has been idle since April 30.

COAL AGE was founded in 1911 by the Hill Publishing Co. In 1915 *Colliery Engineer*, with which *Mines and Minerals* previously had been consolidated, was absorbed by COAL AGE.

When, in 1917, the Hill Publishing Co. and the McGraw Publishing Co. were consolidated to form the present McGraw-Hill Publishing Co., COAL AGE became a member of this larger publishing enterprise. On July 1, 1927, the journal was changed from a weekly to a monthly.

During twenty-five years the editorship has been held successively by Floyd W. Parsons, R. Dawson Hall, C. E. Lesher, John M. Carmody and Sydney A. Hale. The editorial staff of COAL AGE consists of: Sydney A. Hale, R. Dawson Hall, Louis C. McCarthy, Ivan A. Given and J. H. Edwards.

Operators Name Committee To Frame Legislation

Believing that legislation affecting the bituminous coal industry will inevitably be considered at the coming session of Congress, operators from producing districts east of the Mississippi River, representing more than 80 per cent of the tonnage of the country, met Dec. 4 and Dec. 16-17 at the Biltmore Hotel, New York City, to name a committee to prepare a bill for regulation of the industry. A resolution was passed at the first meeting providing that the committee hold meetings to receive opinions and draft a plan designed to effect permanent stabilization.

The resolution also provided that a special legislative committee be created to consist of authorized representatives of the cooperating companies, as follows: one representative each from the Kanawha, Logan, Williamson, Hazard, Harlan, southern Appalachian, Virginia, and Big Sandy districts; eastern Pennsylvania, including Somerset County and Maryland, five representatives; western Pennsylvania, five; Southern smokeless districts, five; Illinois, four; Indiana, two; Ohio, four; northern West Virginia, four; northern West Virginia Panhandle, two; western Kentucky, one; Alabama, one; Southwestern States, one; Rocky Mountain States (Wyoming, Montana and Washington), one; Colorado and New Mexico, one; Utah, one; Iowa, one.

It was agreed that an initial assessment of one-fourth mill per ton on the 1935 annual tonnage be levied on each company to finance the work of the committee. Counsel selected to assist in formulating legislation includes A. M. Liveright, John L. Steinbugler, T. W. Essington and W. C. Spellman, but the committee was authorized to employ other counsel and assistants as deemed necessary.

At the second New York meeting, after discussion of suggestions, the following committee was named: J. D. A. Morrow, president, Pittsburgh Coal Co.; J. Noble Snider, general manager in charge of sales, Consolidation Coal Co.; J. D. Francis, president, Island Creek Coal Co.; H. R. Hawthorne, vice-president, Pocahontas Fuel Co.; C. C. Dickinson, president, Dry Branch Coal Co.; P. C. Sprague, vice-president, Hanna Coal Co. (Delaware); George Enos, president, Enos Coal Co.; Charles O'Neill, president, United Eastern Coal Sales Corporation; George Reed, vice-president in charge of sales, Peabody Coal Co.; E. C. Mahan, president, Southern Coal & Coke Co.; H. L. Findlay, vice-president in charge of sales, Youghiogheny & Ohio Coal Co.; E. H. Davis, chairman of board, New York Coal Co.; W. A. Richards, president, Ashland Coal & Coke Co.; I. W. Rouzer, president, Alabama Mining Institute, and D. T. Buckley, president, New England Coal & Coke Co.

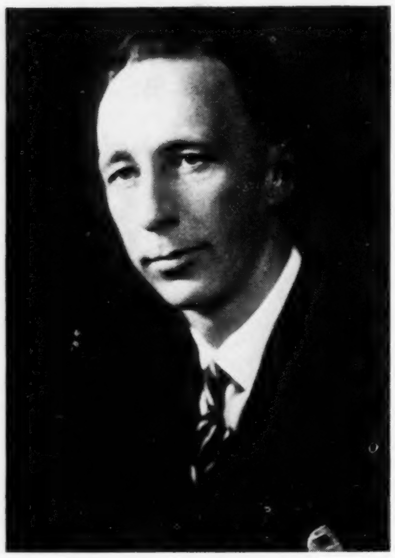
The committee arranged to hold a meet-

ing at the Greenbrier Hotel, White Sulphur Springs, W. Va., on Dec. 20 for further consideration of proposals for legislation.

NCA Sets Up Engineering Bureau

An important step in its active promotion of coal markets in competition with other fuels was made on Dec. 4 by the National Coal Association in announcing that it had set up in its office at Washington, D. C., an engineering department in charge of C. A. Reed. Mr. Reed, who hails from Minnesota, studied engineering at the University of Wisconsin, from which he was graduated in 1914. After serving in the War he became associated with the Green Engineering Co., Chicago, which later was merged with the Combustion Engineering Corporation. More recently he has been with the Pittsburgh Coal Co. as director of the engineering and technical aspects of sales promotion.

In announcing the appointment of Mr. Reed, John D. Battle, executive secretary of N.C.A., called attention to the importance not only of retaining present markets but creating new markets for bituminous coal. Besides oil and gas competition, attention must be given to automatic coal firing by stokers, he said, involving not only questions of sales promotion but coal research. The subject of coal utilization and coal merchandising, he added, "has reached a point where we believe our service to the industry along these lines ought to be still further systematized and expanded."



C. A. Reed

Windfall Tax Held Valid

The government's "windfall" tax on processors was upheld as valid on Dec. 10 in a decision by Judge Robert C. Baltzell in the U. S. District Court at Indianapolis, Ind. Although the decision was in an action wherein Kingan & Co., packers, and 90 other processors contended that assessment of an 80 per cent levy on AAA processing taxes collected was actually a "recapture" measure, the court said the ruling applied also to suits brought by southern Indiana coal companies. Thirty-five southern Indiana operators sued to enjoin W. H. Smith, Internal Revenue Collector, from collecting the "windfall" tax on receipts received prior to the Supreme Court's invalidation of the Guffey Bituminous Coal Conservation Act.

Illinois Stripping Starts

With the shipment of the first cars late in December the new Percy (Ill.) stripping of the Southwestern Illinois Coal Corporation entered the producing lists. Recovering the Illinois No. 6 seam with an average thickness of 6 ft. under 30 to 35 ft. of overburden, the rated capacity of the operation is 3,000 tons per day. Shipments are made over the Missouri Pacific and Mobile & Ohio railroads. Pit equipment includes a Marion 5560 stripping shovel with 26-cu.yd. manganese-steel dipper, a 4121 loading shovel with 7-cu.yd. coal dipper, four Bucyrus-Erie 29-T overburden drills, an L.O.X. plant, and ten 15-ton Mack trucks of the type developed by the Sunlight Coal Co., Boonville, Ind. (*Coal Age*, May, 1936, p. 189), for moving the coal from the pit to the preparation plant. The latter, supplied by the McNally-Pittsburg Mfg. Corporation, is of the seven-track type and includes Norton coal-washing equipment.

Keeping Step with Coal Demand

Bituminous Production

Week Ended	1936 (1,000 Tons)	1935* (1,000 Tons)
Nov. 7	9,369	7,984
Nov. 14	9,833	7,851
Nov. 21	10,058	8,227
Nov. 28	9,568	7,498
Dec. 5	10,258	8,379
Dec. 12	10,457	8,274
Total to Dec. 12	405,438	348,970
Month of October	**43,284**	**37,768**
Month of November	**40,615**	**33,404**

Anthracite Production

Nov. 7	[illegible]	554
Nov. 14	800	599
Nov. 21	1,220	1,000
Nov. 28	1,004	920
Dec. 5	1,251	1,147
Dec. 12	1,188	1,096
Total to Dec. 12	48,465	48,480
Month of October	**4,253**	**4,279**
Month of November	**4,093**	**3,160**

* Outputs of these columns are for the weeks corresponding to those in 1936, although these weeks do not necessarily end on the same dates.

†Adjusted to make comparable number of working days in the two years.

Bituminous Coal Stocks

	(Thousands of Net Tons) Nov. 1, 1936	Oct. 1, 1936	Nov. 1, 1935
Electric power utilities	6,527	5,961	6,455
Byproduct ovens	7,296	6,562	5,986
Steel and rolling mills	1,033	973	1,050
Railroads (Class 1)	4,839	4,964	5,847
Other industrials *	9,968	8,804	10,865
Total	29,393	27,264	30,203

Bituminous Coal Consumption

	(Thousands of Net Tons) Nov. 1, 1936	Oct. 1, 1936	Nov. 1, 1935
Electric power utilities	3,593	3,670	3,259
Byproduct ovens	5,844	5,499	4,396
Steel and rolling mills	1,168	1,059	1,050
Railroads (Class 1)	7,531	6,783	5,847
Other industrials *	10,631	9,069	8,614
Total	28,767	26,080	24,101

* Includes beehive ovens, coal-gas retorts and cement mills.

Union Pacific Coal Co. to Open New 5,000-Ton Mine

Development of a new mine with a capacity of 5,000 tons per day at Superior, Wyo., has been authorized by the Union Pacific Coal Co. The new operation will take over the production load now being carried by the "B," "C," "D" and "E" mines, which are approaching exhaustion. Construction plans approved by the management of the company last month call for the development of the largest tonnage and most modernly equipped deep mine west of the Illinois mining field.

The new operation will be known as the D. C. Clark mine in honor of the late D. C. Clark, who, as general manager of the company, opened up the Superior district in 1906. A series of belt conveyors, operating in a separate slope, will take the coal from mine cars at the bottom to a steel tipple equipped with shaker screens, picking tables and loading booms. There will be two air shafts, one 250 ft. and the other 650 ft., with Aerovane fans. Main haulageways will be laid with 70-lb. steel; both slopes will be supported with structural-steel crossbars and legs set in concrete footings and a 7-ft. clearance will be established between floor and roof.

Based on present plans, approximately four years will be required before the five seams of coal adjacent to the new mine are fully developed. The recoverable acreage, it is estimated, will support an annual output of 1,000,000 tons for 35 years. Orders for structural steel and redwood lumber for slope and shaft lagging already have been placed and contracts for the construction of the slopes and air shafts will be let this month.

To Reopen Old Mine

Old No. 1 Central mine, near Rock Springs, Wyo., will be reopened early in January by the Colony Coal Co., it was announced on Nov. 30.

Julian Oliphant Dies

Julian Oliphant, superintendent, Standard Coal Co., with operations at Wheatland, Ind., died Dec. 12 as the result of injuries incurred when he became caught in the cables of a mining and loading machine. He was a son of F. L. Oliphant, president of the company.

TVA Temporarily Enjoined

A temporary injunction limiting expansions and extensions of power facilities of the Tennessee Valley Authority was granted on Dec. 14 by Judge John J. Gore, in U. S. District Court at Nashville, Tenn., to nineteen utilities pending disposition of their suit attacking the constitutionality of TVA (*Coal Age*, July, 1936, p. 299; December, 1936, p. 595). Some projects not affected by the order include transmission lines, substations and distribution lines under construction. The court also said that the decision would not interfere with TVA construction of dams or terminate electric service to consumers now re-

ceiving TVA power. The Authority is restrained, however, from "soliciting present or potential customers of the complainants."

Judge Gore directed that the injunction remain in force pending further orders of the court or until trial of the power companies' suit attacking TVA on constitutional grounds. The latter is set for March 8. In exempting the projects specified, the court heeded the TVA contention that to halt the construction would throw hundreds of laborers out of work and disturb contracts for materials.

Green River Valley Resumes

The Green River Valley Coal Co., of which E. J. Hartenfeld is president, announces the reopening of its mine at Spottsville, Ky., on Dec. 7.

Silicosis Conference Deferred

Committees appointed by the U. S. Department of Labor to study the various phases of the silicosis problem held meetings at Washington, D. C., during the week of Dec. 13, and on the 16th a joint meeting was held at which progress reports were made to Secretary Perkins. The meeting of the National Silicosis Conference scheduled to be held Jan. 16 (*Coal Age*, December, 1936, p. 597) has been postponed until Feb. 3. In the meantime reports by the various committees will be prepared for presentation at the national conference.

Chauncey Colliery Reopens

The Chauncey colliery, at Plymouth, Luzerne County, Pa., reopened with 300 men at work on Dec. 15, after eight months of idleness. Formerly owned and operated by the George F. Lee Coal Co., the colliery is now owned by the Chauncey Coal Co., of which Jerome McCrystle, Forty Fort, is president and general manager. Mr. Lee had been actively interested in the mine for 36 years when he recently disposed of his holdings.

Minnehaha Plant Burns

Fire of undetermined origin destroyed the tipple and washery at the new Minnehaha strip mine of the Hickory Grove Coal Mining Corporation, near Dugger, Ind., the night of Dec. 14. Value of the plant and other equipment burned is estimated at $100,000. Capacity of the preparation plant, which went into operation Oct. 26, was 250 tons per hour.

Terre Haute Officers Installed

With Webster Hayes, superintendent, Clinton Coal Co., Clinton, Ind., heading the list as president, proceedings at the Dec. 7 meeting of the Terre Haute (Ind.) Mine Foremen's Club included the installation of officers for the coming year. Emil Crampe, foreman, Saxton Coal Mining Co., Terre Haute, entered on his duties as vice-president, while Dewey Loudermilk, mining engineer, Binkley Mining Co., Seeleyville, Ind., and H. A. Cross, general superintendent, Walter Bledsoe & Co., Terre Haute, both reelected, continued as secretary and treasurer, respectively.

C.M.I.A., Observing Golden Anniversary, Studies Timber Rot and Roof Support

THE FOLLY of retimbering and retieing repeatedly during the life of a mine when one set of timbers or ties would turn the trick if the right kind were provided, the prognosis, or forecasting, of roof failure—that "foremost march" of mining "time"—and the progress made in the brief fifty years since the Coal Mining Institute of America started in Monogahela City, Pa., formed the subjects of debate and study at the half-century anniversary of that institution, held Dec. 10-11 at the Fort Pitt Hotel, Pittsburgh, Pa., at which 300 persons were present. The organization boldly undertook the new task of determining what constitutes a gassy mine.

In 1838, nearly 100 years ago, said A. R. Joyce, district sales manager, Wood Preserving Corporation, the use of coal-tar creosote and zinc chloride for wood preservation was patented in England. In the 29 years from 1907 to 1935 inclusive, 5,056,000,000 cu.ft. of timber was treated by vacuum-pressure methods in the United States, using 3,250,000 gal. of creosote oil and 67,000,000 lb. of zinc chloride. Were this quantity of pressure-treated timber installed in a single main-heading mine track as 5x7-in. x 6-ft. sawn mine ties on 2-ft. centers, that track would have to be 1,300,000 miles long; were the timber used to support a main heading with 10x10-in. x 7-ft. legs, 10x12-in. x 9-ft. headers and roofed with 3-in. lagging, that heading would have to be 146,000 miles long.

Table I shows economies effected by some of the big railroads, as presented by Mr. Joyce, but by intelligent use of pressure-treated timber the coal companies could make even greater proportionate savings than the railroads, because the life of untreated mine timber is much shorter and labor cost relatively much higher than in railroad maintenance. When a treated mine tie or timber set is installed, it will return its cost in place with a profit on the expiry of the time when the timber, had it been untreated, would have needed replacement. Basing his figures conservatively on a 15-year life for pressure-treated ties, C. A. Herbert, U. S. Bureau of Mines, estimates that Illinois and Indiana operators could save yearly over $1,500 per mile on main-haulage mine track by not using untreated ties. This compares with $200 to $300 annually saved per mile saved by the railroads.

Rotten timber, asserted Mr. Joyce, should not be used for lagging, nor thrown back in the gob, to produce fungus and spread spores. This bad practice often explains why return air is so detrimental to timber. Bois d'Arc and locust are the untreated timbers most resistant to decay, declared Mr. Joyce, but the quantity available is greatly limited, especially that of the first. If there were no fungus, underground conditions would be more favorable for timber than on the railroads, because underground there is no sunshine, change of temperature and moisture to cause expansion and contraction, to dry out and warp the timber. Preservative material poisons the fungus, inhibits its development and gives the operator the benefit of these better natural conditions.

Table I—What Railroads Are Doing

BIG FOUR RAILROAD

Prior to 1904

Timber used—White oak untreated.
Life of timber—Nine years.

1910-1914

Timber used—Mostly untreated white oak.
Ties replaced per mile annually, 328.

1934

Timber used—98 per cent creosoted.
Ties replaced per mile yearly, 75.
Tie saving per mile yearly, 253.
Total tie saving yearly (14,553 miles), 1,151,909.
Estimated cost of untreated tie in track, $1.40.
Estimated cost of treated tie in track, $2.00.
Saving per mile of using treated ties, $309.20.
Total annual saving by change, $1,407,787.60.

BALTIMORE & OHIO, NEW YORK CENTRAL AND PENNSYLVANIA RAILROADS

1907-1911

Timber used—White oak, white cedar and heart longleaf yellow pine, untreated.
Ties replaced yearly, 243.46.

1931-1935

Timber used—Pressure-treated ties, mostly oak.
Ties replaced per mile yearly, 64.63.
Tie saving per mile yearly, 178.83.
Average total annual saving by change, $11,698,046.60.

Creosote Is Permanent

In reply to Prof. W. R. Chedsey, Pennsylvania State College, Mr. Joyce declared that creosote was the most permanent of all the preservatives used, and in a back heading where there are no live electric wires it is to be preferred. Salt preservatives are preferable wherever there is a fire hazard. For five or six months after wood is impregnated with creosote it is more flammable than wood treated with salt preservatives, but its fire resistance increases rapidly after that period. The fire resistance of wood treated with zinc chloride depends on the quantity of that salt used. One to 1¼ lb. per cubic foot will make wood resistant to fire. Some would assert that less has that effect, and perhaps it is so, but the effect is small.

With dry red oak, creosote will permeate not only the sapwood but the heartwood also, said Mr. Joyce, but the latter in dry white oak and hard maple cannot be penetrated. Creosoted white oak, however, penetrated to refusal, is as durable as thoroughly impregnated red oak, for the fungus cannot reach the heartwood. Oak should be treated at a pressure of 175 lb. per square inch, fir at 100 to 125 lb., and pine at 125 to 150 lb. Wolman salts and creosote treatments cost about the same, but zinc-chloride treatment costs about $3 to $4 less per thousand board feet.

Calamine solution can be used to relieve burns from the handling of creosoted timber. Sometimes cars of such material have to be unloaded by men unacquainted with this work, and when they sweat they rub the water off their faces with their stained hands. In the winter there will be no trouble, but whenever a box car has to be unloaded in summer trouble is likely to

occur with inexperienced labor. The men will develop burns like those resulting from a hot sun. A member of the institute declared that his company kept the timber a while before taking it into the mine and had no trouble. A mixture of linseed oil and lime water is used to reduce the effects of creosote burns. Mine water has no effect on creosote, said Mr. Joyce, but salts are solvent and need a stabilizer. Creosote is to be preferred where water is present.

In the haulageways of Illinois, Mr. Herbert, asserted Mr. Joyce, had found that untreated timber lasts about two years because the return air traveling in them was laden with the seeds of decay organisms. In intake airways, timber should last at least twice as long. In some places untreated timber may last seven years or longer. Conditions must always be considered. Life of untreated timber varies immensely.

Strength is not changed by creosoting. Untreated hickory is stronger than untreated oak, but neither is durable. Properly treated, they will last equally long. One kind of untreated timber outlasts another solely because it makes a less favorable habitat for fungi, but when the several kinds of timber are treated properly they will all resist fungi and be equally resistant to decay, though not equally strong.

Roof falls seem the logical matter to study if accidents are to be greatly decreased, seeing that such a large proportion of the mine accidents are from this cause, urged E. R. Maize, assistant mining engineer, U. S. Bureau of Mines, at the afternoon session. Roof movement had been studied in connection with mechanical mining because the places moved rapidly and observations therefore involved less expense. The convergence of the roof and floor was taken at various points along a moving stepped face maintained along a straight line parallel to another similar stepped face no longer working and a few hundred feet away.

In discussion H. P. Greenwald, acting superintendent, Pittsburgh Experiment Station, U. S. Bureau of Mines, said that construction engineers usually worked within the elastic limit and used a factor of safety, but mining engineers were obliged to exceed the elastic limit and definitely sought to fracture the rock and relieve the stress. Soft bottom, declared S. A. Taylor, consulting engineer, Pittsburgh, Pa., might, by its lack of resistance and by its movement, change the action of the roof and lead observers to confound rise of floor with descent of roof. At Monongahela, the Pittsburgh "sandstone," so massive in places, was only 2 ft. or so thick and the rest so weak a shale that 18 cu.ft. of broken rock would fill completely a 27-cu.ft. box. This roof breaks off close to the rib line; so does the Pittsburgh "sandstone" at Portsmouth, though it is a true sandstone at that point. Other sandstones will bend and refuse to break.

W. R. Chedsey
President-Elect

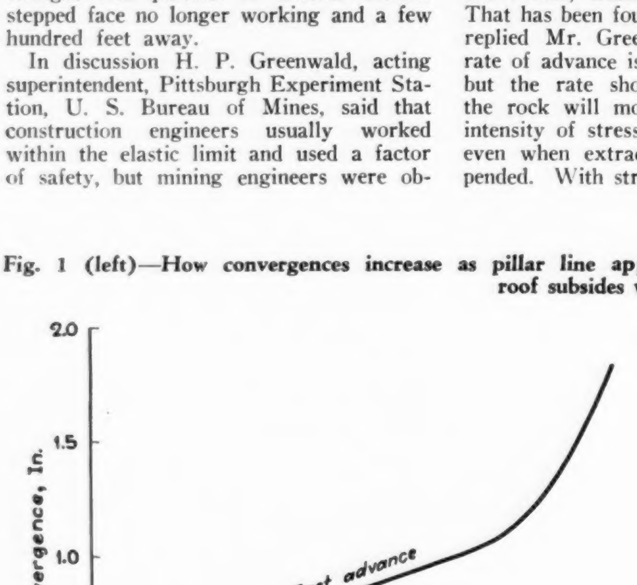
Is there a specific speed of advance best suited to any given condition? asked Richard Maize, State district mine inspector. That has been found to be the case abroad, replied Mr. Greenwald. The most rapid rate of advance is not necessarily the best, but the rate should be uniform because the rock will move and the location and intensity of stress will continue to change even when extraction is temporarily suspended. With stress, cracks open up, some of which hade over the coal and some over the mined area, but these cracks in the roof may not follow either the rib line or the cleats in the coal. One roof break, however, observed E. R. Maize, did follow the rib line in the mine in which observations were being made, but did not occur in the section under direct study. Because of these primordial fractures, declared G. S. Rice, chief mining engineer, U. S. Bureau of Mines, any application of beam theories becomes misleading. In certain parts of Pennsylvania every stratum seems to break in a different direction, giving the roof an integrity it would not otherwise have, said R. D. Hall, engineering editor, *Coal Age*.

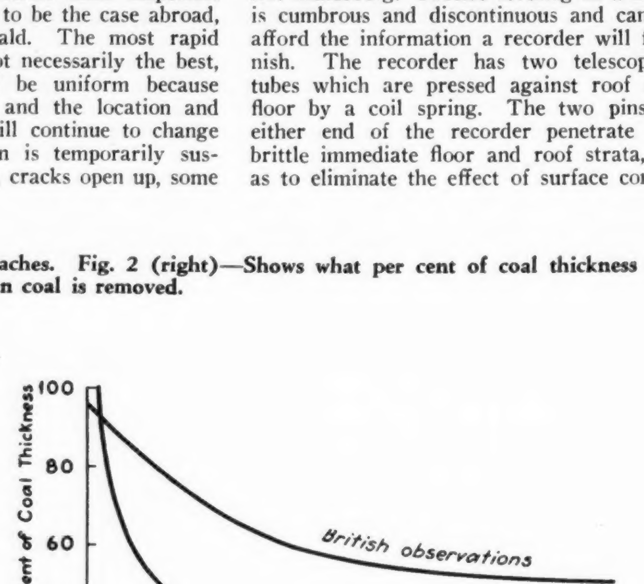
With coal that breaks readily along the cleats it is well, remarked Mr. Greenwald, to arrange to place the break line so that it will follow a diagonal between cleat and butt faces. Joint lines in the rock, said a member, are of different direction from cleat lines in the coal; and clay veins are fault planes and run in a different direction, usually to either cleat lines or ordinary rock fractures. They extend further and higher and have a more profound influence than other jointing planes.

Roof control should be studied because it promotes safety, affords maximum extraction and mimimizes surface damage. Subsidence cannot be entirely prevented, declared H. Landsberg, assistant professor of geophysics, Pennsylvania State College. Weissner, said he, has shown that partial filling is the most beneficial type of stowing. It gives the disturbed strata an opportunity to equalize their stresses and results in rapid and definite settlement. Complete stowing only retards the process.

As hopelessly unscientific as an electrical engineer without voltmeter, ammeter, wattmeter and similar instruments were our methods of gaging roof movement before the convergence recorder arrived, continued Dr. Landsberg. Precise leveling in a mine is cumbrous and discontinuous and cannot afford the information a recorder will furnish. The recorder has two telescoping tubes which are pressed against roof and floor by a coil spring. The two pins at either end of the recorder penetrate the brittle immediate floor and roof strata, so as to eliminate the effect of surface condi-

Fig. 1 (left)—How convergences increase as pillar line approaches. Fig. 2 (right)—Shows what per cent of coal thickness the roof subsides when coal is removed.





tions. A pen records on a revolving drum driven by clockwork the movement of roof and floor toward each other. A smaller recorder without a drum or pen but with an inch scale has been made for the use of the miner. Sometimes the lowering drawslate is so thick that vibration tests such as miners use fail to evidence that the slate is failing under its weight, and this convergence instrument, light and cheap, will show the inch or so of movement that serves to make shallow fractures imminent; such fractures as may snuff out a life but not close a working face.

Fig. 1 shows the rate of convergence for slow and fast work, the rapid increase in rate of convergence as a pillar is drawn, the lessening of rate after caving at the pillar line and the resumption of a high rate as the next pillar is started. The curves show different convergences for slow and fast work, but the crises occur at the same face distances. Weissner, Ullrich and Hoffman in Germany, with levels and so-called shift meters, have noted horizontal shifts in the roof toward the old workings, as well as vertical displacements, of as much as an inch in a few hours, these usually preceding roof falls.

Hunches May Have Merit

Convergence recorders often indicate sudden increases of convergence when rock or coal is blasted. Vibrations have their effect. Scientists should listen to every old woman's tale about night falls, falls in the full moon, falls in relation to earthquakes, to tides and whatnot and test them out by scientific methods; some of the hunches may have merit.

With no cover, the ratio of "subsidence," or descent of surface to seam thickness, is, of course, 100 per cent. Fig. 2 shows that with about 1,400 ft. of cover the subsidence is in America about 20 per cent and in Great Britain about 50 per cent, probably because of longwall operation in the latter case. With a cover of 200 ft., subsidence, according to W. Bellano, a collaborator of Dr. Landsberg, will require at least five years for completion. A cover of 400 ft. will take about eight years to come to rest.

Residents did not know that the ground was sinking over the northern Illinois longwall mines, stated Mr. Rice in discussion, but the engineers knew it and said nothing for fear of suits. The descent was so slow and regular that it was not observed. In one place in Great Britain, pillars 300 or 400 ft. wide have been alternated with gob spaces equally wide. It was doubted whether any subsidence would be experienced, but he expected there would be. In Somerset County, Pennsylvania, said F. W. Cunningham, State mine inspector, miners set up wands ½x2½ in. in cross-section between roof and floor and they serve, like the light convergence recorder of Dr. Landsberg, to reveal the sagging of drawslate. Institute members who stressed floor movement declared that the true significance of convergence might be masked, but Dr. Landsberg declared that European studies had shown that the roof movement always predominates.

Methane percentages should be determined, asserted J. V. McKenna, State mine inspector, Waynesburg, Pa.: (1) at working places, (2) at the last open crosscut where air leaves the working place, (3) at the return end of split where air leaves the working, (4) at the top of goaf falls, (5) at the return side of goaf bleeders, (6) at idle or abandoned sections and (7) at main return outlet. Flame safety lamps, chemical analysis or methane detector may be used for these measurements, but the first will not determine low percentages, the second is accurate but slow, and the methane detector fails to find anything but methane, so a flame safety lamp should always be used to meet this deficiency.

Any mine in which 0.05 per cent of methane can be found in the main return or in any split of air—and 80 per cent of all our tonnage comes from mines having over that percentage in the main return—should be classed as gassy, declared J. T. Ryan, general manager, Mine Safety Appliances Co.; and to serve as a warning, any mine where 0.01 per cent of methane

G. S. McCaa
Retiring President

can be detected anywhere should be classed as potentially gassy. Main return and each split should be tested with an approved methane detector sensible to at least 0.02 per cent and all working places should be examined by competent certified officials with an approved safety lamp until a better device is developed. Thirty per cent of the tonnage mined comes from workings still using open lights and having over 0.05 per cent of methane in the main return.

A mine passing 200,000 cu.ft. of air per minute with 0.05 per cent of methane in the main return is emitting, said Mr. Ryan, 100 cu.ft. of methane per minute, or 144,000 cu.ft. in 24 hours. This would make 2,880,000 cu.ft. of 5 per cent firedamp, which would completely fill with this mixture a heading 6x12 ft. in cross-section and 7.6 miles long.

Where the percentage of gas is below one, responded P. J. Callaghan, State mine inspector, the determination made by the flame safety lamp should be supplemented or checked by one made by an approved methane detector. Any mine generating any gas at all should be declared gassy, added Clyde McDowell, director of personnel, Pittsburgh Coal Co. His company takes that point of view with all its mines. Any mine with gas is gassy, declared J. L. Hamilton, safety engineer, Northern coal mines, Republic Steel Corporation. In determining the relative gassiness of a mine the speed of the air current surely should be considered, countered D. C. Jones, mining extension, Pennsylvania State College, for with heavy enough current a very low percentage of gas will be found, but the mine will nevertheless be generating a dangerous quantity of methane. To this Richard Maize assented, saying the quantity of air might be doubled and that would lift a dangerous mine out of the gassy class. To some extent classification should be by field, for mines were always in danger of cutting into each other—a deep and gassy mine into a shallow and moderately gassy one.

Professor Chedsey having declared that probably no coal mine would be found free of gas after being shut up for a long period, Mr. Greenwald said that the Experimental Mine at Bruceton, Pa., is such a working, and only analysis will reveal traces of gas after 24 hours of complete closure, but Bruceton has crop on three sides and no cover over 125 ft. thick; yet the mine adjacent to it is gassy. A classification of mines according to the gas hazard should be established, said Dr. Rice. The best young men at the Pennsylvania School of Mineral Industries go into metal mining, because the reverberations of these coal-mine explosions—even of those which occurred back in 1907—make them prefer metal mining, declared Dean Edward Steidle.

Economic security, said J. D. A. Morrow, president, Pittsburgh Coal Co., at the banquet, reached its height in the Dark Ages. Invention was discouraged, so jobs were secure, but no advance in human amenities was possible. The American public laments the lack of stability in the coal industry, but it does not favor cooperation to maintain a fair and steady price; it permits taxes on coal lands to rise to such a degree that coal companies are obliged to open unneeded mines to find means of paying such taxes. Competition has been limited. No longer are theft and murder regarded as permissible competition, as in primitive times, but we who have outlawed these cruder competitive methods may well go further in limiting the aggressions of competitors. However, the industry need not despair. Oil and gas will soon pass on their way, and the country will turn again to coal. The chemical industry, now only in its infancy, will depend largely on that mineral for its development.

Education Keynotes Half Century

Education of everybody around the mines is the keynote advance of the last 50 years, according to A. R. Pollack, general manager, Ford Collieries Co., whose experience in mines dates back 49 of those years. Not a college man himself, he had 21 such men at one time in his operational and advisory staff. He could well remember when a dilly of 17 cars broke, ran back in the mine and derailed, shutting in 200 men and 20 mules. As there was no other way out, they had to stay there until the cars were pulled away. In these days such a condition would be impossible.

Safety in mining increases production, lowers compensation costs, and thus makes mining more profitable. A large mine in

central Pennsylvania in 1933 had compensation costs of 6⅜c. per ton of coal mined; men were going home at 11 a.m. or 12 noon every day, not being in physical condition to continue work. The operator was informed that such conditions were a liability to him and unfair to the men, said P. J. Nairn, deputy secretary, Bituminous Division, Pennsylvania Department of Mines. Seeing the justice of these pronouncements, the mine owner launched a program of improvement, and today, with the same equipment and same complement of men, he is producing 50 per cent more coal in seven hours than he could produce in nine hours before the safety campaign was initiated. His compensation costs dropped from 6⅜c. per ton in 1933 to 0.0068c. per ton in 1935. Costs of improvement were completely covered by decrease in compensation costs. A poorly conditioned mine always is costly in operation.

Methane Not Only Offender

Essential factors in the decrease of bituminous-mine hazards listed by Mr. Nairn were: better ventilation, passage of remedial legislation, higher standards in selecting mine officials, use of rock dust and water, permissible explosives and equipment, closed lights and a desire to curtail accidents. Gas is not the cause of all the explosions of gas and dust in coal mines, said Dr. Rice, for it is abundantly proved that coal dust can be directly ignited. Use of an expanding auger in the West in the drilling of shotholes so that almost a keg of powder could be placed in a hole was the cause of many explosions in that section and not gas. The men used large charges to avoid having to undercut the coal.

In presenting the question box, J. J. Forbes, supervising engineer, safety division, U. S. Bureau of Mines, said that in the last six months 25 men had lost their lives in depleted or toxic atmospheres, and the lives of at least 50 other men had been jeopardized. Instancing cases in which officials and mine inspectors appeared to have incorrect notions regarding depleted, toxic and explosive atmospheres, and as to the conditions under which they might be found, W. B. Plank, dean of mining, Lafayette College, advocated the introduction of company schools; such schools can not only teach safety but also inculcate the teamwork by which alone safety can be attained. Schools in mines use their laboratories only about a third of the time; these could be made available for the training of mining men during the intervening time. In his belief the questions presented in examinations for foremen and inspectors cover only part of the ground and need widening, or otherwise the candidates will study only that part of the subject which the questions cover. Training in mining, said Mr. Plank, should commence in secondary schools.

Using the modern electric cap lamp, the average workman has no means, said E. R. Maize, reading a paper prepared by C. F. Keck, superintendent, Jamison Coal Co., for detecting atmospheric deficiencies and for the most part depends on the judgment and thoroughness of mine officials. Each workman should be required to stay in the place assigned him. If he works on the pillar line, he should be taught to keep his dinner pail on the outby side of the place. Sitting in the back crosscut in the warm atmosphere coming through the gob, he may be breathing a mixture not fit to support life.

Speaking for himself, E. R. Maize remarked that his inquiries had developed that many men who had safety lamps did not understand how to use them, possibly because with mechanization lamps have been more generally distributed and those receiving them have not been instructed in their use.

Trespassers who enter abandoned workings to get information for a lease, steal coal or mine equipment have no protection and seldom carry a safety lamp, said Reese Nicholas, chief mine inspector, Pittsburgh Coal Co. Such men are not readily convicted in the courts. A country-pit operator will open a mine along the crop adjoining old workings and sooner or later he will cut through. Then, taking his carbide light, he will start exploring. It is a wonder more deaths do not occur.

In carbon dioxide, advised Bartley Murphy, safety inspector, H. C. Frick Coke Co., "don't trust the canary; he may fool you. Take a carbon-monoxide detector. Be sure also when doing rescue work that your men take orders from no one but you, however ready you may be to cooperate and accept good advice. The team boss is responsible for the lives of his men." In some mines unorganized men rush to do rescue work, added Clyde Lutton, safety director, H. C. Frick Coke Co., and the team should be organized to prevent it, for untrained, unprotected men can destroy not only themselves but the trained equipped men on whom they force themselves and for whom often they provide more men to be rescued.

At the Friday afternoon session, Carel Robinson, manager of mines, Kellys Creek Colliery Co., dilated on fifty years of progress in coal-mine mechanization. Men have not been laid off by the introduction of machinery, he declared. In 1935 there were 237 per cent more men employed than in 1910 and they produced 233 per cent more coal. Thus in a broad sense the coal industry by the records can sustain a plea of "not guilty" to the charge that technical improvement has been so rapid that readjustments could not be made.

Among miscellaneous dicta, Mr. Robinson says: Blowers provide a current of air of high velocity, which picks up fine coal and deposits it on sides, roof and timbers, thus increasing hazards. Laboratory instruments devised to record the thickness of roof strata to the line of cleavage above it should make it possible to set posts more efficiently. Research groups also are working on an instrument to record the slightest subsidence of roof over a working face.

Accident Rates, Clearfield Bituminous Coal Corporation

	Hand Mining	Conveyor Mining
Frequency rate, all accidents	120.5	127.9
Severity rate.....	16.51	10.39
Tonnage per man-hour worked....	0.794	1.266
Tonnage per fatal accident	535,218	1,602,462
Tonnage per compensable accident	14,100	22,400
Tonnage per lost-time accident....	6,630	9,653

Mine officials should be teachers. They should not bully, they should not do the work of their employees, but they should demonstrate to each man, possibly two or three times, how each operation should be done, said Dean E. A. Holbrook, University of Pittsburgh. One of his students out for a summer job was put to setting grips on a rope, but was not shown how he should do it. He tied up the mine for two hours just because of lack of instruction. Men should not only be instructed but after that should be made to do the work themselves under sympathetic supervision to demonstrate their understanding of the method of operation. He condoned the use of violent language by officials only after patient effort had been made to find another approach. The practice of giving a man too much to do in the hope he will do enough of it makes the employee resentful and convinced that the boss does not understand the work. Managers may not know all about every branch of mining, but they must know how one job ties in with another and how to plan their work. Nervous energy and good health are needed; suggestion and encouragement, a liking for men, fairness, loyalty to promises, freedom from bluffing and good temper. With these and a good general knowledge of mining a manager should go far.

Comparing mechanical loading with hand loading in the same mines, three times as much tonnage was mined per fatality, over 50 per cent as much per compensable acci-

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New Institute Officers

W. R. CHEDSEY, professor of mining, Pennsylvania State College, was elected president of the Coal Mining Institute of America at the fiftieth annual meeting, Dec. 10-11, at Pittsburgh, Pa. Other officers elected are: first vice-president, C. W. Pollack, general manager, Ford Collieries Co., Curtisville, Pa.; second vice-president, N. G. Alford, consulting engineer, Eavenson & Alford, Pittsburgh, Pa.; third vice-president, J. V. McKenna, State mine inspector, Waynesburg, Pa.; secretary-treasurer, G. W. Grove, U. S. Bureau of Mines, Pittsburgh, Pa.

Managing directors: J. J. Forbes, U. S. Bureau of Mines, Pittsburgh, Pa.; E. A. Holbrook, dean, school of engineering, University of Pittsburgh; G. S. McCaa, State mine inspector, Pittsburgh; F. B. Dunbar, general superintendent, Hillman Coal & Coke Co., Mather, Pa.; M. L. Coulter, safety engineer, Clearfield Bituminous Coal Corporation, Indiana, Pa.; R. M. Black, professor of mining, University of Pittsburgh; C. F. Keck, superintendent, Jamison Coal Co., Latrobe, Pa.; C. A. McDowell, personnel director, Pittsburgh Coal Co.; G. W. Riggs, Mine Safety Appliances Co., Uniontown, Pa.; E. A. Siemon, division general superintendent, Hillman Coal & Coke Co., California, Pa.

dent and almost 50 per cent as much for accidents of all kinds, all in favor of mechanical loading, triumphantly asserted T. F. McCarthy, general superintendent, Clearfield Bituminous Coal Corporation. Room-and-pillar working is used in both forms of mining; the coal is 36 to 42 in. thick, the output is 2,000,000 tons annually, of which 35 to 40 per cent is loaded mechanically.

With scoop or conveyor loading, almost twice as much was loaded per lost-time accident at the mines of Pennsylvania Coal & Coke Co. as with hand pick or cutting machine without mechanical-loading aid, declared Alexander Jack, general superintendent. His figures for scoop or conveyor loading include all lost-time accidents from loading head to face and for hand pick or cutting machine from room switch to face of room.

Accident Rates, Pennsylvania Coal & Coke Co.

	Scoop or Conveyor	Hand Pick or Cutter
Jan. 1, 1930–Nov. 16, 1936	12,839	7,200
1930 (first year)	5,114	5,958
Current year	16,000	9,000
Mine No. 3*, current year	17,000	7,350
Mine No. 17**, current year	24,000	13,000

* Roof generally good; daily production, 2,500 tons; 60 per cent conveyor mining.
** Roof only fair; daily production, 1,000 tons; 80 per cent conveyor mining.

DISTRIBUTION OF FATALITIES

	Per cent
Haulage	47.62
Hand pick or cutter	33.33
Scoop or conveyor	9.52
Miscellaneous	9.52
	99.99

9½ per cent of fatalities while 54 per cent of the tonnage was mechanically loaded.

Mechanical loading at the Pennsylvania company's mines began in 1926; 5,487,774 tons of conveyor coal have been mined with one fatality; 1,870,000 tons of scoop coal with one fatality, or 7,358,599 tons with only two fatalities.

Seven per cent of the accidents in six years have come from mechanical loading, yet at this time 20 per cent of the output is thus produced, declared T. J. Davies, safety inspector, Pennsylvania Electric Co., Mine No. 5, Robindale. In six years there have been 256 accidents, 129 of which occasioned no loss of time, with 127 causing a loss of 9,920 days, this including a permanent disability. Mechanical loading caused 18 accidents with a loss of time of 295 days, about 29 per cent of the total lost-time accidents. Two brothers had five of these accidents, losing in all 105 days, or 36 per cent of the lost-time accidents chargeable to mechanical loading. Neither man is still employed. The roof is good and the seam mined is the "B," or Lower Kittanning.

At the mines of the Butler Consolidated Coal Co., comparisons between mechanical-loading and hand-loading accidents cannot be made, as the mine is operated entirely by machines, declared W. D. Walker, Jr., safety engineer. Frequency has dropped from 329.22 in 1930 to 39.50 in 1936 (to Dec. 1); tons per lost-time accident have mounted from 3,226 to 19,526; tons per compensable accidents from 6,535 to 26,391 and tons per fatal accident from 254,860 to 356,226, the last figure being unfortunately low due to two fatalities during the year—as many as occurred in the entire five preceding years. Tons per fatality for 1930-1936 have been 657,257.

As mechanical loading is given every possible advantage, such as a good uniform seam and the best of roof available, and as many accidents directly chargeable to mechanical loading are listed as falls of roof and coal, explosions or gas ignitions, a true story of the relative accident frequency and severity of hand and mechanical loading is not available. In his opinion, said George Steinheiser, State mine inspector, safety has not increased with increased mechanical loading.

To obtain suitable definitions of (1) a gassy coal mine and (2) a slightly or potentially gassy coal mine, and to find means and devices for determining the above classifications, the president of the institute was asked in a resolution to appoint three operating men, two State inspectors and two mining engineers to report on this question severally or as a whole. Another resolution requested the Director of the Bureau of Mines to permit the training of men in rescue and recovery operations with the aid of the plant and personnel of the Experimental Mine at Bruceton.

STOKER SALES MOUNT

Sales of mechanical stokers in October last totaled 18,319, according to statistics furnished the U. S. Bureau of the Census by 108 manufacturers. This compares with sales of 15,040 units in the preceding month and 10,038 in October, 1935. Figures for the first ten months of this year show that 70,539 units of all types and sizes were sold, compared with 39,259 in the corresponding period a year ago. Sales by classes in the first ten months of this year were as follows: residential (under 100 lb. of coal per hour), 62,957; apartment-house and small commercial heating jobs (100 to 200 lb. per hour), 3,565; general heating and small high-pressure steam plants (200 to 300 lb. per hour), 1,291; large commercial and high-pressure steam plants (over 300 lb. per hour), 2,726.

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Mine to Tap Raleigh Field

A charter was granted on Dec. 16 to the Beckley Fire Creek Coal Co., capitalized at $500,000, which will start an entirely new operation in the Raleigh County field of West Virginia. Incorporators are John Laing, president, Wyatt Coal Co. and several other companies; A. W. Laing, James Martin, J. O. Jenkins, Fred Blue, all of Charleston, W. Va. The head of the new company said it would have an estimated output of 3,000 tons daily and would start shipping coal by June 1. He also said that contracts had been let for a steel tipple to cost $100,000, had constructed houses and that extensive grading operations were under way.

Flooded Mines Reopen

Operations at No. 10 Tunnel and William A collieries of the Kehoe-Berge Coal Co., near Pittston, Pa., were resumed on Dec. 7 after being idle since last March, when the swollen waters of the Susquehanna River flooded the workings. It will require several more months, however, before these operations will be able to work full force, as considerable water remains to be pumped out.

Keck Indicted in Bombings

Three indictments naming 41 persons, mostly mine workers affiliated with the Progressive Miners and including William Keck, president of the anti-Lewis organization, were returned Dec. 16 at Springfield, Ill., in connection with a federal investigation of railroad bombings in Illinois. The indictments charge a conspiracy from December, 1932, to August, 1935, during which 23 coal trains were bombed, six bombings attempted and one bridge burned. Keck was taken into custody and placed in $10,000 bond. Ray Tombazzi and Dan McGill, other prominent Progressives, were ordered to furnish $30,000 bonds for their release, as they are named in all three indictments.

The bombings began shortly after a revolt of central Illinois U.M.W. members against a wage scale given emergency approval by John L. Lewis, international president. The rebels formed the Progressive Miners union.

Industrial Notes

William E. Umstattd has been elected president of the Timken Steel & Tube Co., subsidiary of the Timken Roller Bearing Co., in addition to continuing as president of the parent company. He succeeds Frederick J. Griffiths, resigned. H. H. Timken, Jr., a vice-president of the Timken Steel & Tube Co., has been made executive vice-president, in addition to his present post of vice-president of the bearing company. John E. Fick has been appointed general superintendent of the steel and tube mills of the roller bearing company, vice K. B. Bowman, resigned.

Thermoid Rubber Co., Trenton, N. J., has enlarged its mechanical rubber goods division with the addition of three new district supervisors. George W. Skirm has been appointed district manager in the Indiana district; H. C. Griffen has been made district manager in the New York territory, and S. S. Tower has been placed in charge of New England territory.

Alexander T. Bush, recently industrial salesman and special representative of the Johns-Manville Co., has joined the sales staff of the industrial materials division of the Owens-Illinois Glass Co., where he will be identified particularly with package sales of fibrous glass pipe covering and industrial insulation.

Ruberoid Co., manufacturer of asphalt and asbestos building products, has acquired the properties of the Lang Co. at Gloucester, N. J., devoted to the production of dry felts used in the making of roofing and building products.

Longer Workday With No Increase in Pay Asked by Appalachian Operators

APPALACHIAN operators offered to renew the existing wage rates per day, per ton and per yard, adjusted to the basis of an eight-hour day, five-day week in a communication from their negotiating committee transmitted on Dec. 15 to the office of John L. Lewis, president, United Mine Workers, at Washington, D. C. The present contract, which provides a basic wage of $5.50 per day in the North and $5.10 in the South for a seven-hour day, five-day week, will expire on March 31 next, and, in accordance with its terms, a joint conference to negotiate for a new contract is scheduled to convene in New York City on Feb. 17.

The operators' offer, which is the outcome of proposals formulated at a meeting held two weeks previous, proposes a two-year term for the new agreement, carrying it to March 31, 1939. These proposals assert that the series of increases in wages, shortening of hours, improvements in working conditions, and acceptance of collective bargaining in the bituminous coal industry since 1933 are without parallel in industry, but that to maintain its present wage structure and prosper the bituminous coal industry must secure a larger proportion of the fuel business of the nation. To do this, it is maintained, it must better its competitive position with other fuels

Competing Fuels Make Inroads

At present, according to the operators' letter to Mr. Lewis, the industry is continuing to lose business to oil, gas and hydro-electricity, and the equalization of competitive conditions with these other fuels, which the operators had been led to expect, when signing an agreement with the U.M.W. in 1933, has failed to materialize. Attention also is called to the efforts of the industry to obtain lowered freight rates for coal to the extent of 10c. per ton to permit a lowered delivered cost to consumers.

Wage increases since 1933 in the Appalachian field, the operators' letter declares, totaled 100 per cent, and during the same time working time has been reduced from eight hours per day, six days per week, to seven hours per day, five days per week. The increase, measured in dollars, the operators assert, is in excess of $175,000,000.

The resolution, adopted by the Appalachian operators on Dec. 2 in New York City, proposes that the hourly rates be adjusted in accordance with the proposal that the workday be established on an eight-hour basis so that the same earnings per day per worker will be maintained as is now paid for a seven-hour day: and that the unit rates for piecework remain the same as under the existing agreement. The prospective increased earnings of pieceworkers under the 40-hour week, if the anticipated increased production affords the same number of working days per year as is now worked, the letter states, would amount to more than 14 per cent.

"These proposals," the communication adds, "are made in all earnestness by the operators' negotiating committee and are advanced in the spirit of cooperation to promote the interests of all engaged in the industry. To the extent that the industry improves in working time by this proposed change in hours by increasing production, all workers will increase their earnings. The further stipulation is made that all questions involving intra- and inter-district wage differentials and the question of the North-South differential remain in *status quo* during the term of the new agreement, and their consideration be deferred until the next succeeding joint wage conference.

The letter is signed by the eight members of the negotiating committee, as follows: J. D. A. Morrow, president, Pittsburgh Coal Co.; L. E. Woods, president, Crystal Block Mining Co.; L. T. Putman, general superintendent, Raleigh-Wyoming Mining Co.; D. A. Reed, general manger of operations, Consolidation Coal Co.; P. C. Thomas, vice-president, Koppers Coal Co.; Ezra Van Horn, executive vice-president, Ohio Coal Control Association; M. L. Garvey, Pocahontas Fuel Co., Inc., and Charles O'Neil, president, United Eastern Coal Sales Corporation.

A second communication dispatched to Mr. Lewis on the same date announces the selection of the above committee to conduct the preliminary arrangements on behalf of the operators and, unless changed by the joint conference, to negotiate a new agreement. The later letter also suggested that the conference be held at the Biltmore Hotel, New York City.

Following is the first letter of the operators to Mr. Lewis:

The operators of the Appalachian districts, at a meeting held in New York City Dec. 2, 1936, referred the following resolutions adopted by them to their negotiating committee:

"*Resolved*, That the operators offer to the United Mine Workers of America a continuation of the present wage schedules per day, per ton, and per yard: That the work day be established on an eight (8) hour basis of a five (5) day week; that the hourly rates be adjusted in accordance therewith so that the same earnings per day per worker will be maintained as is now paid for a seven (7) hour day; and that the unit rates for piecework remain the same as under the present Appalachian wage agreement dated Sept. 26, 1935; and that this agreement be entered into for a period beginning April 1, 1937, and continuing in effect to April 1, 1939.

"*Resolved*, That all questions involving intra-district, inter-district, wage differentials, and the question of the North-South differential, shall remain in *status quo* during the period of the wage agreement effective April 1, 1937, and consideration of these issues postponed until the next succeeding Appalachian joint wage conference."

Since 1933 the operators represented by the undersigned committee have increased the wages paid to the mine workers in their mines 100 per cent, and during the same time have reduced their hours from eight hours per day, six days per week, to seven hours per day, five days per week, or a thirty-five hour week. This wage increase, measured by dollars, is in excess of $175,000,000 per year. The effect of the action upon wages in the Appalachian fields, taken together with the effect upon other districts throughout the country, has been to increase wages to the miners of the nation over $250,000,000 per year. These various increases, effective Aug. 1, 1933; Oct. 1, 1933; April 1, 1934; and Oct. 1, 1935, represent a series of increases in wages, shortening of hours, improvement in working conditions, and acceptance of the principle of collective bargaining that cannot be matched by any other industry in the United States. These increases and improvements in the workers' conditions have not been paralleled in the bituminous industry in any like period and have never been approached by other industries at any time. The operators' negotiating committee is pleased to make this statement, but believe they have the right to suggest an examination of the economic effects upon the owners, as well as the workers, during this period of time.

We respectfully suggest that during this period of attempted reconstruction of the industry, production costs and important changes made in our scale agreements, while benefiting the industry as a whole, has been particularly beneficial to the workers, but has not produced a situation that permits a growth of the production of bituminous coal. The operators' negotiating committee believes the bituminous coal industry must secure a larger proportion of the fuel business of the nation to maintain its present wage structure and to produce a stable condition in the industry. At present the industry is still losing business to oil, gas and hydro-electricity.

When the operators first entered these arrangements with the United Mine Workers of America they had every reason to expect that competitive conditions with other sources of power would be changed so that bituminous coal could fairly compete for its proper proportion of the business of the nation, but this has not been done.

The operators' negotiating committee asserts that the operators are doing everything in their power to have the transportation costs on bituminous coal lowered to the extent of 10c. a ton. The earning opportunity of the pieceworkers, provided opportunity to work is offered, will be increased. It is our belief that the proposed reduction in transportation rates and the small saving in cost of production that will result from acceptance of the operators' proposal will place coal in a more favorable competitive position with other sources of power. To the extent that the industry improves in working time by this proposed change in hours by increasing production, all workers will increase their earnings, and in the case of the pieceworkers to a greater extent than is the case with day workers. If, as we hope and expect, the increased production results in the same number of days worked per year as is now worked, the pieceworkers would increase their earnings by over 14 per cent.

These proposals are made in all earnestness by the operators' negotiating committee and are advanced in the spirit of cooperation to promote the best interests of all engaged in the industry. We will support the merits of this proposition by such statistical and other data as will be pertinent and by which we hope to prove the soundness of our claims. These data will be furnished to the joint conference.

The second letter:

The present Appalachian joint wage agreement, dated Sept. 26, 1935, provides among other things:

"A joint conference of representatives of the Eastern Bituminous Coal Association, Georges Creek and Upper Potomac Coal Association, Somerset County Coal Operators' Association, Western Pennsylvania Coal Control Association, Ohio Coal Control Association, Michigan Coal Operators' Association, Northern Panhandle of West Virginia Coal Operators' Association, Northern West Virginia Subdivisional Coal Association, Operators' Association of the Williamson Field, Big Sandy-Elkhorn Coal Operators' Association, Hazard Coal Operators' Association, Kanawha Coal Operators' Association, Logan Coal Operators' Association, Southern Appalachian Coal Operators' Association, New River Coal Operators' Association, Pocahontas Operators' Association, Winding Gulf Operators' Association, Greenbrier Coal Operators'

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PERMISSIBLE PLATES ISSUED

TWO approvals of permissible equipment were issued by the U. S. Bureau of Mines in November, as follows:

Myers-Whaley Co.: sizes 3 and 4 "Whaley Automat" loading machines; 25-hp. motor, 500 volts, d.c.; Approval 276A; Nov. 18.

Jeffrey Manufacturing Co.: Type 44-L loading machine; 10-hp. motor, 250-500 volts, d.c.; Approvals 310 and 310A; Nov. 28.

Association, Harlan County (Kentucky) coal operators signatory hereto, and Virginia coal operators signatory hereto, and the International Union United Mine Workers of America and Districts 2, 3, 4, 5, 6, 16, 17, 19, 24, 28, 30 and 31, shall be held in the City of New York, N. Y., Feb. 17, 1937, to consider what revisions, if any, shall be made in this agreement as to hours, wages, and conditions of employment."

In accord with this requirement of the agreement, the coal operators representative of the groups named therein have held several meetings preliminary to the assembly of the joint conference on Feb. 17, 1937. One of the actions taken at these meetings was to constitute the following named persons as a negotiating committee to conduct preliminary arrangements for the assembly of the conference and to take care of such other matters as were referred to it by the operators, including, unless changed by the joint conference, the duty of negotiating the next succeeding wage agreement for the Appalachian districts: Messrs. L. E. Woods and P. C. Thomas, from the Southern high-volatile fields; M. L. Garvey and L. T. Putman, of the Southern low-volatile fields, each of whom shall carry one vote; Ezra Van Horn, J. D. A. Morrow and Charles O'Neill, each of whom shall carry 1⅓ votes, representing the Northern districts; D. A. Reed, representing the Northern West Virginia district and who shall vote under the rule governing Northern West Virginia district adopted in the Appalachian conference of 1935.

The operators' negotiating committee are acting under the instructions and direction of all those operators constituting the Appalachian joint wage conference, as provided in the agreement of Sept. 26, 1935.

This committee suggests that the Conference be held in the ballroom of the Biltmore Hotel, New York City, on Feb. 17, 1937. Please advise if this arrangement is satisfactory to you.

In connection with the approaching negotiations, the directors of the Northern West Virginia Subdivisional Coal Association have authorized Brooks Fleming, Jr., assistant to the general manager of operations, Consolidation Coal Co., as president of the association, to reappoint the scale committee which has heretofore served for the district in negotiations with the miner's union scale committee for District 31. The committee is composed of George S. Brackett, statistician, Consolidation Coal Co., chairman; D. L. Brown, general superintendent, Federal division, Koppers Coal Co.; S. D. Brady, Jr., president, Osage Coal Co.; W. Clark Dobie, general superintendent, Jamison Coal Co.; F. K. Day, general superintendent, Pardee-Curtin Lumber Co.; A. W. Hawley, Preston County Coke Co.; Truman E. Johnson, vice-president, Hutchinson Coal Co.; Fred A. Krafft, director, employee service, Consolidation Coal Co.; J. Howard Magee, Eastern manager, West Virginia Coal & Coke Co.; E. E. Ober, Katherine Coal Mining Co.; D. A. Reed; Howard W. Showalter, president, Monongahela Rail & River Coal Corporation; J. I. Snoderly, general manager, Bethlehem Fairmont Coal Co.; E. H. Reppert, president, Reppert Coal Co.; A. Lisle White, general manager, Fairmont & Baltimore Coal & Coke Co.; J. D. Walker, Walker Coal Mining Co.; William Findlay, Simpson Creek Collieries Co.; A. C. Beeson, Four States Coal Co.; D. J. Carroll, president, Continental Coal Co.; W. H. Green, Green Smokeless Coal Co.; Carl L. Hornor, president, Maureen Coal Co.; John Lowry, West Virginia Coal & Coke Co.; R. A. Courtney, Courtney coal mining interests.

With the expiration of the wage contract in sight, the United Mine Workers announced on Dec. 17 that the members would be assessed $1 each in January and February to raise $1,000,000 as a financial reserve "to meet any contingency" in connection with developments growing out of contract renewal negotiations.

Sealing, Safety Gains, Power Plants and Cleaning Highspot Indiana Meeting

HOW SEALING promotes safety, economy and efficiency; the major factors in the decline in fatalities from mine fires and explosions; the advantages of mine power plants and the characteristics of the Baum-type jig were the principal topics at the annual meeting of the Indiana Coal Mining Institute, held Dec. 12 at the Hotel Deming, Terre Haute, Ind. Technical sessions were presided over by B. H. Schull, general manager, Binkley Mining Co., Seeleyville, Ind., retiring president.

The benefits derived from sealing, stated Wright Gaston, assistant superintendent, Dresser mine, Walter Bledsoe & Co., Terre Haute, grow out of two major mine activities—ventilation and drainage—with safety, efficiency and economy entering into both. Ordinarily, seals are built to facilitate ventilation and prevent water

H. P. Smith

New president, Indiana Coal Mining Institute

from worked-out areas from entering the live workings.

Considering ventilation from the safety standpoint, absence of seals results in manifold dangers in a gaseous mine, as it becomes difficult to inspect the operation properly as the worked-out area increases, and, even if this could be done, sudden releases of gas would be a hazard, not to mention the danger to the mine examiner going through the old workings or to unauthorized persons entering them. With sealing, which permits conducting the air directly from the fan to the face without danger of pollution from old territories, the better current more readily removes small accumulations of gas from working places. In addition, the fresher air provided is an aid to increasing the efficiency of the miner and makes him more alert and less prone to injuries.

"Economies effected through sealing are real economies." At the Dresser mine, the worked-out area is many times the size of the live sections, yet 42,000 c.f.m. is circulated four miles through 4x10-ft. headings with a water gage of 4 in. and a power input of less than 45 hp. "Savings in power in one year's time amount to enough to do considerable sealing." Two examiners inspect the mine, but, if seals were not installed, twelve would be required to do the job properly. The savings in this respect alone have paid for the 150 seals in service, costing an average of $200 each, with considerable over besides.

Considered from the drainage standpoint, seals are a real safety measure in a mine where the overlying material consists largely of sand and gravel constantly filled with water from a river. Where sealed-off sections are used as sumps, the efficiency of the pumper and pump are stepped up, as constant attendance on the pump is not necessary and it can operate at full load.

"A seal, if it is to be worth anything, must be built of incombustible materials" and must be properly hitched into the rib and floor and up to solid top to make it air and water tight," declared C. A. Herbert, supervising engineer, U. S. Bureau of Mines, Vincennes, Ind. In addition, the roof on either side of the seal must be properly supported to prevent subsequent breaks that might cause leaks. Seals should be fitted with pipes and valves to permit the air or water behind them to be sampled or pressure readings to be taken. Sealing abandoned sections may be advantageous by preventing acidification of the water.

Frequent Sampling Necessary

Samples of atmospheres behind seals, as well as the air on both the intake and return sides, should be taken at intervals to determine if the seals are tight. If so, and there is no break in the surrounding strata, oxygen should drop to 1 to 2 per cent in the closed-off area in 30 to 40 days. Where a mine fire has been sealed off, analysis of the atmosphere behind the seals is of great importance in determining when to open them. Seals of this character should be left in place until CO disappears, even though a low oxygen reading indicates that they are tight.

The most important factor in sealing, contended James Hyslop, manager of operations, Walter Bledsoe & Co., Terre Haute, is to arrange for seal installation while the mine is being projected. Next, the service that the seals will undergo should be determined as far as possible and the seals engineered to withstand it. Closing off old workings or holding back water now are the primary objectives in most sealing campaigns, stated J. S. Anderson, superintendent, Saxton Coal Mining Co., Terre Haute, who stressed determination of the service to be met as a prerequisite to seal design. Birch Brooks, engineer for the same company, pointed out that emergency flood doors are installed at Saxton pending erection of the seals for each worked-out section. Lee Haskins, superintendent, No. 1 mine, Bell & Zoller Coal & Mining Co., Zeigler, Ill., expressed the opinion that it would be practically

impossible to work a large mine without sealing off old territories, even though water was not a factor.

Major mine explosions and fires (each resulting in five or more fatalities) caused 7,116 deaths in the period 1906-30, or 15 per cent of the total, whereas in the period 1931-35 such disasters killed only 264 men, or 5 per cent of the total, declared K. L. Marshall, associate mining engineer, health and safety branch, U. S. Bureau of Mines, Pittsburgh, Pa., in opening a discussion of "Some Coal-Mine Practices That Have Reduced Major Explosion and Fire Hazards." Disasters falling in these classes, said Mr. Marshall, have been grouped, "with but few exceptions, under the following ignition sources: open-flame lamps; flames from black blasting powder, dynamites and other non-permissible explosives; electric sparks or arcs from electric circuits; and non-permissible electrical equipment."

In about 75 per cent of these major explosions, gas was present at the point of ignition, while in the remainder the dust was ignited directly. "There are, however, few, if any, records of widespread explosions covering a relatively large area of a mine in which the explosion was not propagated by coal dust." In addition to the more common sources of ignition, fires have been started in combustible material found or taken into the mines, by heat from the flow of current through electrical resistance and by spontaneous combustion.

Electric Cap Lamp Use Grows

Progress in the removal of sources of ignition may be gaged by the facts that 325,000 permissible electric cap lamps are in use in mines producing approximately 60 per cent of the United States tonnage; that permissible explosive use has grown to 30 per cent of the total, although many mines with explosion hazards have yet to adopt this agent; and that 290 separate pieces of coal-mine equipment falling in fourteen classes have been granted approval plates. In addition, the Bureau of Mines has a list of 32 "approved" cables.

"The electric arc and spark from a current of sufficient intensity to ignite are fully understood and appreciated by mining men as ignition hazards. However, the fire hazard due to the flow of current through high-resistance combustible material appears to be less easily understood and appreciated." Giving point to his remarks by staging actual ignitions of anthracite and bituminous coal with a 5-amp. 110-volt current, Mr. Marshall summarized the results of tests by the electrical section of the U. S. Bureau of Mines to discover the liability of coal to ignition through flow of current through it.

When tested across the bedding planes, most coals in the solid, dry state are good insulators. However, when a good "carbon" path is present, as in metamorphosed anthracite or in streaks of fusain in bituminous coal, "current is likely to flow, resistance to drop, and firing occur." If a carbon path is not naturally present, electric arcing can readily establish a coke path, through which current can flow and ignite the coal. While such ignitions are termed "unlikely," they are not impossible, and consequently, Mr. Marshall contended, electrical distribution systems should be installed so that the possibility of contact with coal is eliminated or, failing that, so that the current can be cut off when the circuits are not in use or if it is necessary to keep them in service, so that the current automatically will be interrupted in case of a ground or short.

While fires and explosions should be stopped before they occur, it is necessary even with the best of supervision and operating practices to provide protection against man failure or unforeseen developments. Mr. Marshall, therefore, strongly urged the use of rock dust, not only as an explosion preventer but also as a fire-prevention and fire-fighting medium. In air free from explosive gases, so-called low-volatile, or "smokeless," coal dusts require up to 50 per cent of incombustible material to make them safe; high-volatile coals may require 65 to 75 per cent. In 1933, only 25.4 per cent of all coal-mine employees were working in rock-dusted mines. Of these mines, only a few were adequately dusted. In Utah, 84.9 per cent of employees had rock-dust protection; in Ohio, 5.7 per cent. In addition, rock dust is being used more frequently in fighting mine fires and has been found to have the advantages of a quick reduction in smoke and fumes as the fire is covered, as well as elimination of steam and its bad effects on the roof when water is used.

Opening the discussion, H. G. Conrad, general manager, Knox Consolidated Coal Corporation, Bicknell, Ind., declared that in addition to its safety advantages, sprinkling of the coal at the face resulted in an increase of 25 to 50 tons per loading-machine shift through dust elimination. In a safety program, management must take the lead, basing its work on a study of previous injuries and their causes. Men should be instructed in the best and safest way to perform their respective tasks, and mines and equipment should be kept in good condition, with proper guards where required.

Stating that the increased tonnage due to sprinkling at Knox Consolidated amounted to 10 per cent, Mr. Herbert told of a mine fire in Illinois this year which was fought with 80 tons of rock dust thrown on by hand. In loading out 300 tons of rock after the fire, hot material was satisfactorily cooled and protection assured by throwing dust on it, and the same system was followed in loading out burned coal and ashes from a fire at still another Illinois operation in 1936. Mr. Conrad declared that to prevent difficulties where several sprinkling hoses are attached to a single pump a borehole was run to the surface, into which the water was bypassed when the hose nozzles were closed. Water is obtained from behind seals and consequently is non-acid. One mine, said Mr. Marshall, taps into the column lines for sprinkling water and has constructed a storage pond on the surface to provide water on idle days.

Mine power plants under present conditions offer, with some exceptions, the possibility of real economies in power costs, declared C. M. Garland, of C. M. Garland & Co., Chicago. One favorable factor is the production at most mines of a product which, while unsalable, can be employed for steam raising at little or no cost, as it is possible, in view of improvements in combustion equipment in late years, to burn "almost anything containing up to 20 per cent moisture and 35 per cent ash, with a calorific value as low as 6,500 B.t.u. per pound." In addition, large mines in most instances must have a boiler plant of some kind for heating purposes and nearly every operation has some kind of an engineering organization. Power-generating equipment therefore is the only addition with which operating men are not entirely familiar, and men to look after this generating equipment is about the only addition to the mine force necessary. Usually, the chief electrician is capable of supervising the operation.

Another favorable factor is that efficiency, in view of the fact that a fuel of no commercial value can be used, is of secondary importance. Also, the presence of much generating equipment on the market which, while not of high efficiency, can be rebuilt and made just as reliable as new equipment is another advantageous element in that the cost of the generating plant can be kept down to about half that of a plant with new units.

Suiting Plant to Power Needs

Different types of operations, continued Mr. Garland, require different types of power plants. Where a steam hoist is employed, the plant should be so designed that the steam from the hoisting engine can be used to generate a portion of the power. Such plants usually are equipped with mixed-pressure turbines. At small shaft mines it often is possible to generate power with non-condensing engines, provided a boiler plant designed to use waste fuel furnishes the steam. At shaft mines with electrically driven hoists, the power installation invariably will consist of high-pressure turbines fed with steam generated in water-tube boilers. While the load fluctuates widely, it can be successfully handled with water-tube boilers if the plant is properly designed.

The slope mine offers a more favorable load condition than either of the above types of shaft operations, as the coal usually can be brought to the surface on some form of conveyor taking a uniform quantity of power. At strip mines, peaks are high and the demand is subject to wide fluctuations, while the average current taken is comparatively small. Developments in late years, however, have demonstrated that the isolated power plant can handle strip-mine loads as satisfactorily or more so than a long transmission system, which is subject to disturbances due to fluctuating shovel demands, said Mr. Garland.

"With the advent of the coal-washing plant, the operator was confronted with

Coming Meetings

• Anthracite Club of New York, Inc.: seventh annual banquet, Jan. 14, Hotel Astor, New York City.

• College of Mines, University of Washington: annual mining institute, Jan. 19-24, Seattle, Wash.

• American Institute of Mining and Metallurgical Engineers: annual meeting, Feb. 15-19, 29 West 39th St., New York City.

• Central Pennsylvania Coal Producers' Association: annual meeting, April 20, Altoona, Pa.

an increase in the consumption of power and the problem of disposing of large quantities of refuse coal" consisting of either gob varying from almost dust to several inches in size and a residuum of slurry from the washer usually varying from ⅛ in. down to zero in size. The gob usually is so high in ash (about 50 per cent) that it cannot be used as a fuel, while the slurry, if allowed to dry, can be burned on grates with considerable satisfaction. The Antioch Power Co. plant, Linton, Ind., which serves several mines, generates at least 98 per cent of its power from slurry, bearing out the contention that this fuel can be used if suitable combustion chambers and firing equipment are employed.

"We have not only used slurry running as low as 7,000 B.t.u. and containing up to 20 per cent of refuse, but we also have successfully used the fine refuse from dedusting, which necessarily has a higher calorific value but which sometimes is just as difficult to burn as the wet product from the washing box." The Kings Station plant of the Princeton Mining Co., Princeton, Ind., uses minus 1/16-in. dry dust in power generation, while the former Illinois Coal Corporation plant, Nason, Ill., used gob containing up to 35 per cent ash. The new plant of the Central State Collieries, St. David, Ill., at present operates on a mixture of one-half slurry and one-half screenings, but will operate entirely on slurry as soon as a dry supply can be accumulated.

How Power Costs Vary

Cost of generating plants for coal mines, Mr. Garland pointed out, necessarily varies greatly in accordance with the size of the operation and the character of the service. In the case of the deep shaft, considerable money can be saved by employing a steam hoist and using the exhaust in generating equipment. As a rule, in plants of this character, new equipment must be employed throughout, as the mixed-pressure turbogenerator is somewhat of a special machine and very few are on the used-equipment market. In the case of mines using straight high-pressure turbines, plants usually can be built with used equipment and the cost therefore will run somewhere between 40 and 60 per cent of the cost of a new plant. Operating cost may vary from $15,000 to $30,000 per year, and at these same operations the purchased-power bill may vary all the way from $35,000 to $200,000 per year.

With H. S. Banholzer, electrical engineer, Knox Consolidated Coal Corporation, Bicknell, Ind., leading, underground power distribution was the first subject of the discussion, which revolved around the distance which it is economically feasible to transmit direct current and the relative merits of different types of cables. H. P. Smith, general manager, Princeton Mining Co., Terre Haute, reported that an investigation showed that to transmit 250 volts a distance of 4,500 ft. with a total loss (positive and return) of 20 per cent, a 1,500,000-circ.mil cable was necessary. W. H. Davis, Simplex Wire & Cable Co., in comparing cable types, stated that the lead-steel unit was a little better from the standpoint of mechanical strength and a little safer from the electrical standpoint. On the other hand, the armor is subject to electrolytic action from stray currents and when once dented will not spring back to its original shape. Rubber-jacketed cables now are available in types with very low moisture-absorptive characteristics, thus widening their field of application. Rubber-jacketed types also are lower in first cost and, while not quite so strong as metallic types, still will stand a lot of abuse. Furthermore, the wall will spring back to shape after a blow.

Leading off the general discussion of power-plant operation, Mr. Conrad stated that one of his company's mines generates its own power, while the other, as well as the mine of an affiliated company, operate on purchased power. Mechanization of loading has resulted in a major increase in power consumption, and made an addition to Knox Consolidated No. 1 power plant (hand-fired) necessary. Mechanization also involved the hoisting of a larger percentage of impurities, with the result that Bradford breakers were installed at No. 1 and No. 2. At No. 2, the coal end from the breaker is cleaned in an air-sand plant to make a commercially salable product, whereas at No. 1, producing about 3,000 tons per day, the reject runs about 165 tons per day, of which about 75 per cent is salvaged in the breaker and used to make all the power for the operation. It is charged to the power plant at a good price, but even at that the cost of power at No. 1 in November was less than 5c. per ton, compared with 9c. at the No. 2 mine.

The Kings Station power plant, said Mr. Smith, is the company's best duff customer, and all coal supplied the plant is charged to it at the top market price. The mine is equipped with a steam hoist, with the exhaust going to a mixed-pressure turbine, and as a result of intensive mechanization, power use has doubled in late years. Cost per ton, however, has not shown any material increase, and is less for an average daily output of 5,000 tons than at the Ebbw Vale mine, constructed years ago for an output of 2,000 tons with hand loaders and operated with purchased power and an electric hoist. A major factor in this comparison was the presence of a demand charge in the Ebbw Vale power schedule. As compared with other present-day mines operating on purchased power, the per-ton cost at King's Station is about half.

Problems involved in the preparation of coal with jigs and advances in this type of equipment to meet growing demands for increased capacity and higher efficiency were the subjects of a paper by George L. Arms, Jeffrey Manufacturing Co., who detailed the development of the Baum equipment since its introduction into the United States and summarized the salient features of the Jeffrey Baum-type unit.

"In the coal-mining industry," said Mr. Arms, "the problem of coal preparation is a difficult one because of the large quantities of material to be handled and the narrow zone to which the specific-gravity separation must be restricted. It is not possible to predicate coal-treatment plants solely on the processing requirements, because of the low unit value of the product after processing. In order to preserve a stable economic set-up, the cost of such plants must be kept within limits which will permit amortization. This has resulted in what might be termed 'commercial compromises' in the orthodox coal-preparation plant. The industry must develop concentrating apparatus capable of treating the comparatively larger quantities of material peculiar to the coal industry at higher efficiencies than before, and at the same time keep the cost of the plant within economic limits."

The distinguishing feature of the Jeffrey Baum-type jig, said Mr. Arms, is the introduction of a differential stroke in the mechanism producing the pulsations in the flow of water, permitting more efficient separation with an increase in capacity. In addition, the jig incorporates adjustment features extending to the slope of the screen supporting the coal bed, uniform flow of water across the width of the jig and admission of air and water to each cell, all tending to increase the flexibility of the unit as a coal-washing machine.

Discussion following Mr. Arms' address turned largely on the possibility of dedusting wet coal on vibrating screens, which found all speakers agreed that it was impossible to secure efficient results at the present time.

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Institute Who's Who

H. P. Smith, general manager, Princeton Mining Co., Terre Haute, Ind., was elected president of the Indiana Coal Mining Institute at the annual meeting in December. Mr. Smith succeeds B. H. Schull, general manager, Binkley Mining Co., Seeleyville, Ind. Other officers were chosen as follows:

First vice-president—C. A. Herbert, supervising engineer, U. S. Bureau of Mines, Vincennes.

Second vice-president—H. G. Conrad, general manager, Knox Consolidated Coal Corporation, Bicknell.

Third vice-president—Thomas W. Faulds, Binkley Mining Co., Clinton.

Secretary-treasurer—Harvey Cartwright, commissioner, Indiana Coal Operators' Association, Terre Haute.

Members of the executive board are: R. A. Templeton, vice-president, Templeton Coal Co., Sullivan; H. A. Cross, general superintendent, Walter Bledsoe & Co., Terre Haute; J. S. Anderson, superintendent, Saxton Coal Mining Co., Terre Haute; A. K. Hert, superintendent, Snow Hill Coal Corporation, Terre Haute; F. M. Schull, general superintendent, Binkley Mining Co., Clinton; David Ingle, Jr., superintendent, Buckskin mine, Ingle Coal Co., Buckskin; and B. H. Schull.

Personal Notes

N. J. Anderson, formerly superintendent of the Talleydale mine, Snow Hill Coal Corporation, Terre Haute, Ind., has been made superintendent of the Mohawk mine, Hamilton Coal Mining Co., Latta, Ind., and the Paxton mine, Paxton Coal Corporation, Paxton, Ind.

Dr. C. A. Barnes has joined the technical staff of Battelle Memorial Institute, Columbus, Ohio. Dr. Barnes, who received a Ph. D. degree from the University of Washington, has been assigned to the fuels division, where he will investigate

research problems in the combustion of fuels.

BYRON BIRD, chief concentration engineer, Battelle Memorial Institute, Columbus, Ohio, was reelected secretary of the Ohio Valley Section, American Institute of Mining and Metallurgical Engineers, at the annual meeting. Formerly known as the Ohio Section and including only members from the Buckeye State, the section now embraces membership from parts of Indiana, Kentucky and West Virginia.

ELWOOD BOOTH has been appointed superintendent of the Lillybrook Coal Co., Lillybrook, W. Va.

J. STEPHEN BOND has been appointed combustion engineer of the Franklin County Coal Corporation, Chicago. A graduate of Purdue University, Mr. Bond has been engaged in recent years in combustion engineering work for public utilities and other industries.

GEORGE BRANNON has been made superintendent of the Webb Coal Mining Co., operating in Boone County, West Virginia.

E. L. BULLER formerly connected with the Hudson Coal Co., has been appointed sales engineer of Anthracite Industries, Inc. Graduated from Lafayette College in 1925 with an E.M. degree, Mr. Buller joined the Hudson company's student corps, soon becoming a sales engineering representative of the company and eventually being placed in charge of the equipment laboratory as well as the chemical laboratory. In 1932 he was appointed research engineer for the Hudson company.

JOHN A. BURLAS, associated for the last fifteen years with the Jamison Coal & Coke Co., has been appointed State mine inspector in charge of the Fifteenth bituminous district of Pennsylvania, comprising the northern part of Cambria County.

D. A. CROGAN has been appointed assistant general foreman at the Point Lick No. 4 mine of the Hatfield-Campbell Creek Coal Co., in Kanawha County, West Virginia.

FLOYD FIELDS has been made foreman at the Avis mine of the Avis Eagle Coal Co., Logan County, West Virginia.

E. E. FINN, connected with the Lehigh Navigation Coal Co. since 1913, has been appointed assistant to the president of Anthracite Industries, Inc. He has been associated with the latter organization since Aug. 1 and has assisted in the development of its program.

WILLIAM FORD has been appointed division superintendent of the Davis Coal & Coke Co. at Boswell, Somerset County, Pa.

FRED HARLESS has been appointed foreman at the Edwight No. 4 mine of the Raleigh-Wyoming Mining Co., Raleigh County, West Virginia.

HARRY HIGGINBOTHAM, superintendent of No. 32 mine of the Consolidation Coal Co., at Owings, W. Va., has been elected president of the Central West Virginia Coal Mining Institute.

J. H. HORNE has been made foreman of Eccles No. 6 mine of the Crab Orchard Improvement Co., Raleigh County, West Virginia.

ESSAU JACKSON has been appointed foreman of Minter No. 2 mine of the E. C. Minter Coal Co., Raleigh County, West Virginia.

C. O. KANE, formerly employed at Nellis mine of the Nellis Coal Corporation, Nellis, W. Va., has joined the mining extension department of West Virginia University as instructor, succeeding E. M. White, resigned.

GEORGE J. LEAHY, vice-president, Little Betty Mining Corporation, with operations in Linton, Ind., has been elected and his election confirmed as a director of the National Coal Association. He was named to fill the vacancy caused by the death of Charles G. Hall.

CARL P. MANN has been named foreman of No. 5 mine of the United States Coal & Coke Co., McDowell County, West Virginia.

JAMES MARTIN has been made general manager of the Morrison Coal Co., operating in Wyoming County, West Virginia.

J. A. MEADOWS has been appointed foreman by the Red Jacket Junior Coal Co., Mingo County, West Virginia.

WILLIAM PERFATER has been made superintendent of the Morrison Coal Co., Glen Morrison, Wyoming County, W. Va.

JAMES H. PIERCE has resigned as vice-president, treasurer and director of the Wyoming Valley Collieries Co., which operates the Harry E and Forty Fort collieries, at Swoyersville, Pa. This action, Mr. Pierce announced, effective Nov. 27, was a sequel to his disposing of his stock interest in the company.

J. M. PILCHER has been appointed research engineer in the fuels division of Battelle Memorial Institute, Columbus, Ohio. He holds the degrees of Chemical Engineer and Master of Science from Virginia Polytechnic Institute.

ARTHUR PRUITT has been named foreman of the Hardy mines of the Isaban Coal Co., Isaban, McDowell County, W. Va.

LEON RUFF has been appointed superintendent of the Wheatland (Ind.) mine of the Standard Coal Co., vice Julian Oliphant, deceased.

CHARLES M. SHOFFNER has been elected president of the Alleghany River Mining Co., Kittanning, Pa., effective Dec. 1. He succeeds R. M. Shepherd, who resigned to devote his entire time to his duties as president of the Pittsburg & Shawmut Railroad Co. Mr. Shoffner will continue as president of the Ringgold and Reid coal companies, with which he has been identified for a number of years.

ROY SMITH has been appointed foreman of the Beards Fork mine of the Koppers Coal Co., Fayette County, West Virginia.

LESTER SPAULDING has been made general foreman of the Buffalo Chilton Coal Co., Kistler, Logan County, W. Va.

FRANK T. SWAIN has been elected vice-president and treasurer of the Wyoming Valley Collieries Co., Luzerne, Pa., vice James H. Pierce, resigned.

J. E. TOBEY, manager, fuel engineering division, Appalachian Coals, Inc., was elected chairman of the Ohio Valley Section, American Institute of Mining and Metallurgical Engineers.

R. E. TUGGLE has been named foreman of the Hugheston mine of Kanawha Coals, Inc., Hugheston, W. Va.

E. M. WHITE, instructor in the Madison district for the mining extension department of West Virginia University, has resigned to become superintendent at the Dorothy Gordon mine of the Detroit Mining Co., Gordon, W. Va.

WILLIAM G. CAPERTON, president, Scotia Coal & Coke Co., was elected president of the New River Coal Operators' Association at the annual meeting on Dec. 8. Other officials elected were: vice-president, GILBERT SMITH, general manager, Dunedin Coal Co.; treasurer, P. M. SNYDER, president, Castner, Curran & Bullitt; secretary and traffic manager, S. C. HIGGINS.

S. J. DICKENSON, general manager, Mary Helen Coal Corporation, Coalgood, Ky., was reelected president of the Harlan County Coal Operators' Association at the annual meeting. Other officers renamed were: vice-president, CHARLES S. GUTHRIE, general manager, Harlan Fuel Co., and secretary, GEORGE S. WARD.

DAVID INGLE, president, Ingle Coal Co., has been reelected president of the Coal Trade Association of Indiana, and JONAS WAFFLE has been renamed as managing director. HUGH B. LEE, vice-president, Maumee Collieries Co., is vice-president, and these new directors have been named: EARL SHAGLEY, secretary-treasurer, Walter Bledsoe & Co., and J. B. F. MELVILLE, receiver, Electric Shovel Coal Corporation.

W. G. POLK, president, Tennessee Jellico Coal Co. and Block Coal & Coke Co., Knoxville, Tenn., was reelected president of the Southern Appalachian Coal Operators' Association at its annual meeting. Other officers named were: executive vice-president and secretary, L. C. GUNTER; first vice-president, B. E. CHEELY, president, Fork Mountain Coal Co.; second vice-president, JOHN W. WILLIAMS.

L. T. PUTMAN, general superintendent, Raleigh-Wyoming Mining Co., was elected president of the Winding Gulf Operators' Association at the annual meeting, Dec. 5. Other officers chosen were: vice-president, J. A. HUNT, vice-president, Lillybrook Coal Co.; secretary-treasurer, P. C. GRANEY, general manager, C. C. B. division, Koppers Coal Co. (reelected); assistant secretary, HAL M. SCOTT (reelected).

Maumee Plans Stripping

A new stripping operation with a capacity of aproximately 2,000 tons per day will be started three miles south of Linton, Ind., next summer by the Maumee Collieries Co., Terre Haute, Ind. The new operation (Mine No. 23) will be located on the Chicago, Milwaukee, St. Paul & Pacific R.R. and will recover the Indiana No. 4 seam, averaging 3 ft. in thickness. Overburden thickness averages 35 ft. Stripping will be done with a Marion 5480 shovel with 18-cu.yd. manganese-steel dipper. The coal will be loaded with a Marion 480 shovel and will be hauled with trucks. The preparation plant, to be designed and built by the Maumee organization, will be an eight-track operation equipped with shaker screens, picking tables, four loading booms, rescreening plant and mixing conveyor.

Mechanical Loading and Coal Preparation Hang Up New Records in 1935

UNDERGROUND mechanical loading of bituminous coal and mechanical cleaning of that coal in surface plants established new records in 1935, according to figures released a few weeks ago by the U. S. Bureau of Mines. The quantity so loaded was 47,206,477 tons. This was an increase of 5,773,742 tons over 1934, compared with an increase of 9,956,000 tons in the total output of soft coal. In terms of percentages of total deep-mined output, the amount mechanically loaded in 1935 was 13.6 per cent of the total—a gain of 1.4 points over the preceding year, when the percentage was 12.2. In the mechanical-cleaning division, the 1935 tonnage was 45,361,021, or 12.3 per cent of the total production, compared with 11.1 per cent in 1934.

Analysis of the data on mechanical loading shows that mobile machines were used in fifteen States in 1935 and only ten in 1934. The northern group of States (Illinois, Indiana, Ohio and Pennsylvania) accounted for 20,530,012 tons of the total of 24,675,248 tons handled with mobile equipment; this was an increase of 13.7 per cent over 1934. Southern States (Alabama, Kentucky, Tennessee, Virginia and West Virginia) reported 1,228,730 tons handled by mobile machines—an increase of 90.7 per cent over 1934. States west of the Mississippi River produced 2,913,506 tons with mobile machines—an increase of 40.3 per cent over 1934. The total number of mobile machines in use increased from 534 to 657.

Conveyor Loading Increases

Pit-car loaders handled 11,098,466 tons and were used in eight States in 1935; in 1934, the tonnage was 11,088,919 and this equipment was used in ten States. An increase of nearly 850,000 tons in coal handled with this equipment in Illinois was offset by larger declines in Indiana and Kentucky and decreases in several other States. The total number of units reported in use dropped from 2,288 in 1934 to 2,098 in 1935. Hand-loaded face conveyors handled 7,719,998 tons in 1935—a gain of 1,212,242 tons, or 18.6 per cent, over 1934. Tonnage so handled increased 800,856 in the southern group, 454,886 in the western group and decreased 43,500 in the northern group. The number of mines having conveyor installations rose from 114 in 1934 to 136 in 1935.

Self-loading conveyors, such as the duckbill, are most widely used in Wyoming, although six other States report a limited use of such equipment. The number of units jumped from 157 to 179 duckbills; all of this increase was in Wyoming. Tonnage loaded by scrapers increased from 1,004,480 in 1934 to 1,118,201 in 1935. The southern group increased its scraper output 194,003 tons—principally in Alabama; the western group output increased 56,487 tons—principally in Wyoming; scraper-loaded tonnage in the northern group declined 136,769 tons. The total number of scraper units in use was 78.

There were 319 mines reporting the use of mechanical loading equipment in 1935. Of this number, 114 confined their mechanical loading to mobile machines, 160 used only conveyors (pit-car loaders and other hand-loaded conveyors) and 45 mines used both loading machines and conveyors. Comparative changes in mechanical loading by principal types of machines, by States, for the two years are shown in Table I.

While the total output of bituminous coal in 1935 increased only 2.8 per cent over the 1934 figures, the production at mines served by mechanical cleaning plants showed an increase of 14.2 per cent. The number of mechanical cleaning plants increased from 292 to 320. Wet-cleaning plants still predominate. Breakdown by types for the two years is given in Table II. The total number of plants, explains the Bureau of Mines, represents those in operation in 1934, plus new plants in 1935, less plants idle in 1935 or abandoned in 1934. The new plants added in 1935 "will add considerably more tonnage to the national output of cleaned coal compared with the loss due to idle or abandoned plants."

Pennsylvania showed the greatest increase in the tonnage cleaned mechanically in 1935 compared with the preceding year (see Table III), but "this increase resulted largely from the greater amount of coal washed by steel companies for their own use and not because of any increase in coal cleaned at the mines." Illinois ranked second in tonnage increase. While Alabama showed a decline in the quantity of coal washed, the drop was not proportionately as great as in total tonnage for the State, so that the percentage of the State

Table I—Comparative Changes in Mechanical Loading by Principal Types of Machines

State	1934, net tons			1935, net tones		
	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total
Alabama	142,505	928,781	1,071,286	286,483	1,017,170	1,303,653
Arkansas	*	*	208,826	*	*	292,064
Colorado	*	*	65,076	97,269	100,050	197,319
Illinois	11,643,841	6,838,506	18,482,347	12,809,739	7,703,343	20,513,082
Indiana	4,199,727	1,202,959	5,402,686	4,986,408	781,288	5,767,696
Kentucky	*	*	743,629	*	*	533,250
Maryland	....	*	*	....	*	*
Missouri	....	*	*	....	*	*
Montana	876,837	271,591	1,148,428	959,596	331,777	1,291,373
New Mexico	*	....	*	*	....	*
North Dakota	*	....	*	*	....	*
Ohio	1,136,398	....	1,136,398	1,488,303	....	1,488,303
Oklahoma	*	....	*	*	....	*
Pennsylvania	1,385,791	5,162,187	6,547,978	1,387,241	5,082,244	6,469,485
Tennessee	*	*	*	87,898	165,681	253,579
Utah	565,385	34,108	599,493	836,574	61,544	898,118
Virginia	....	384,956	384,956	*	*	651,807
Washington	*	*	340,685	*	*	429,617
West Virginia	691,071	673,865	1,364,936	1,197,119	862,203	2,059,322
Wyoming	2,956,704	614,900	3,571,604	3,774,960	764,325	4,539,285
Undistributed	237,801	1,484,822	364,407	476,423	1,948,839	518,524
Total	23,836,060	17,596,675	41,432,735	28,388,013	18,818,464	47,206,477

[1] Includes mobile loaders, scrapers, duckbills and other self-loading conveyors.
[2] Includes hand-loaded conveyors and pit-car loaders.
* Included under "Undistributed" to avoid disclosing individual operations.

Table II—Classification by Types of Equipment Used in Bituminous-Coal Cleanings

(Coal cleaned at central washeries operated by consumers in Colorado and Pennsylvania is included)

	Net tons of clean coal		Number of plants	
	1934	1935	1934	1935
Wet methods:				
Jigs	14,012,058 [1]	15,735,039	129 [1]	138
Concentrating tables [2]	1,116,154 [1]	1,117,789	10	9
Jigs in combination with concentrating tables [2]	1,227,413 [1]	1,549,422	13 [1]	15
Launders and upward-current classifiers	15,167,450	18,454,238	86	93
Unspecified	5,500	....	1	...
Total wet	31,528,575	36,856,488	239	255
Pneumatic methods	8,297,984	8,504,533	53	65
Grand total	39,826,559	45,361,021	292	320
Number of plants using both wet and pneumatic types			24	32

[1] Information obtained in 1935 indicated that one of the plants classed as using jigs only in 1934 was actually using jigs in combination with concentrating tables. The figures for 1934 have been revised accordingly.
[2] A more representative figure for the use of wet tables is indicated by combining the totals for concentrating tables with the totals for jigs in combination with concentrating tables. This shows a wet gain of 323,644 tons, or 13.8 per cent, for 1935.

Table III—Bituminous Coal Mechanically Cleaned: 1934 and 1935

(Coal cleaned at central washeries operated by consumers in Colorado and Pennsylvania is included)

State	Clean coal in net tons		Percent of State output mechanically cleaned	
	1934	1935	1934	1935 [1]
Alabama	7,150,888	6,841,269	78.2	81.3
Colorado	417,295	492,874	8.0	8.4
Illinois	1,195,588	3,154,128	2.9	7.2
Indiana	1,127,654	1,283,555	7.6	8.3
Kansas and Missouri	813,488	1,169,351	13.9	19.2
Kentucky	308,735	351,568	.8	.9
Michigan and Ohio	1,260,654	1,151,546	5.9	5.4
Pennsylvania	15,652,268	17,844,642	17.4	19.7
Tennessee	341,530	341,117	8.3	8.3
Virginia	515,810	389,548	5.5	3.9
Washington	400,336	614,771	28.9	39.0
West Virginia	10,486,956	11,613,813	10.7	11.8
Other States [2]	155,357	112,839	....	....
Total	39,826,559	45,361,021	11.1	12.3

[1] Preliminary, based on final totals for cleaning and preliminary estimates for State totals and total production for United States in 1935.
[2] For 1934 includes Arkansas, Maryland, Montana, New Mexico and Oklahom
For 1935 includes Arkansas, Maryland, Montana and New Mexico.

Table IV—Relative Growth of Mechanical Loading, Hand Loading and Stripping

Year	Anthracite: Mechanical loading underground	Anthracite: Stripping	Anthracite: Hand loading underground	Bituminous: Mechanical loading underground	Bituminous: Stripping	Bituminous: Hand loading underground
Index numbers:						
1927	100	100	100	100	100	100
1928	106	113	94	131	108	95
1929	156	89	93	230	110	99
1930	201	118	85	285	108	83
1931	197	177	69	288	103	65
1932	244	185	54	217	107	53
1933	295	229	48	229	99	57
1934	418	269	55	251	113	62
1935	417	*228	*48	286	*127	*62

* Preliminary.

output cleaned actually showed a small increase: i.e., from 78.2 per cent in 1934 to 81.3 per cent in 1935.

Although production of Pennsylvania anthracite declined 6,165,000 tons in 1935, the quantity loaded mechanically fell off only 5,429 tons. The decline in tonnage loaded mechanically was approximately 0.1 per cent. In 1935, scrapers and mobile loaders (principally the former type of equipment) accounted for 2,662,026 tons, compared with 3,017,741 tons in 1934; pit-car-loader tonnage declined from 63,106 to 60,045, while tonnage handled by hand-loaded face conveyors (including shaker-chute equipment with duckbills) rose from 6,203,639 tons in 1934 to 6,556,986 tons in 1935. The total tonnage loaded mechanically was 9,279,057 in 1935, as against 9,284,486 tons the preceding year. Anthracite mines had 508 scraper and mobile-loader units and 1,615 conveyors and pit-car loaders in operation in 1935; for 1934 the figures were 531 and 1,376 respectively. The Northern field led in mechanical loading with 7,416,776 tons in 1935; the Eastern Middle field reported 428,286 tons; Western Middle field, 1,242,705 tons, and the Southern field, 191,290 tons.

Possible Uses for Coal Visioned by Research

(*Concluded from page 21*)

considerably the environmental temperature. At this point the fuel may be said to be ignited.

New methods of breaking up coal chemically have been devised, said H. C. Howard, also of the laboratory: (1) pyrolysis in the molecular still, (2) thermal decomposition in solvents at elevated temperatures, (3) hydrogenation, (4) oxidation, (5) halogenation and (6) action of alkali.

In the first the coal is heated to 932-1032 deg. F. at a pressure of 1/100,000 of an atmosphere or less in a molecular still and condensed at a much shorter distance from the evaporating than the free path of the evaporating molecules. No collision with surfaces hotter than the evaporating surface is possible, so there can be no secondary thermal decomposition. The condensate contains not only the usual liquid hydrocarbons and phenolic substances but brown amorphous solids readily soluble in polar aromatic solvents such as phenol, but almost completely insoluble in petroleum ether or ethyl ether. These substances have been designated "bitumens," and might serve as fillers and softeners in compounding rubber or plastics.

Solvents form another means of breaking down coal. With a tetralin solvent, coal too dirty for market might possibly afford a substantially ash-free product suited to hydrogenation or combustion. Waxy and resinous materials are extracted abroad from German brown coals, and large quantities of these products are sold in this country. Perhaps extracts from our bituminous coals could be so sold.

Edenborn coal hydrogenated at 662 deg. F. is converted largely into distillable products varying from oils to resins. The semi-solid and resinous products might be mixed with rubber, plastics, paints and varnishes.

Apparently the best lubricating material consists of large hydro-aromatic nucleuses with long aliphatic chains attached. Unfortunately, the hydro-aromatics and partially hydrogenated aromatics from coal lack these chains, though by synthetic means they might be added. In hydrogenation by adding only a little hydrogen ash-free liquid oils for diesel use would be obtained.

Humic acids prepared by reaction of dilute nitric acid on coal contain carbon, hydrogen and oxygen in approximately the ratio indicated by the empirical formula $C_6H_{3.8}O_{2.2}$ as well as about 2 per cent of nitrogen and 0.6 per cent of sulphur. Some soil chemists hold that these humic acids themselves have specific beneficial effects, and for years the U. S. Department of Agriculture has been studying ammoniated peat. Humic acids prepared by oxidation of coal with dilute nitric acid and simple neutralization of the acids with ammonia yield a product with 7 to 8 per cent nitrogen. Though it has less nitrogen than ammonium sulphate, on decomposition it leaves organic matter in the soil that should be beneficial or at least not harmful, as is the sulphate residue. Humic acids found naturally in clay deposits are believed to be an important factor in determining behavior of clay dispersions; these humic constituents some clays lack. Acids as manufactured from coal could be added to clay, assuring uniformity in quantity and molecular weight.

Only one-tenth as much benzene can be obtained by thermal decomposition of a Pittsburgh-seam coal as by oxidation followed by decarboxylation. Heating such non-aromatic structures as cellulose to 482 deg. F. develops aromatic structures and the benzene yield from a cellulose char prepared at 752 deg. F. is of the same order as that from a Pittsburgh-seam coal. When thoroughly oxidized the humic acids become completely soluble in water, in acid and alkaline aqueous solutions, in ethyl alcohol and in ethyl ether, migrate rapidly through parchment or cellophane in an electrical field and have a lower molecular weight. They might possibly be used for esterification with simple alcohols to produce plasticizers or be made to react with polyhydric alcohols to form resins. The valuable synthetic alkyl resins are now made by reaction of a dicarboxylic acid, such phthalic acid, with a trihydroxy alcohol such as glycerin. Presumably a tricarboxylic or higher acid would serve as well with the cheaper glycols but polycarboxylic acids are not available commercially. Aromatic acids formed by oxidation of coal appear to have as an average four carbonyls per molecule and these might turn the trick; also, they might serve as tanning agents.

Mine Fatality Rate Shrinks

Coal-mine accidents caused the deaths of 84 bituminous and 6 anthracite miners in October last, according to reports furnished the U. S. Bureau of Mines by State mine inspectors. With a production of 42,935,000 tons, the bituminous death rate in October was 1.96 per million tons, compared with 2.72 in the preceding month, when 37,200,000 tons was mined. The anthracite fatality rate in October last was 1.41, based on an output of 4,253,000 tons, as against 2.66 in the preceding month, when 3,764,000 tons was produced. For the two industries combined, the death rate in October last was 1.91, compared with 2.71 in the preceding month and 2.35 in October, 1935.

Comparative fatality rates for the first ten months of 1935 and 1936, by causes, are given in the following table:

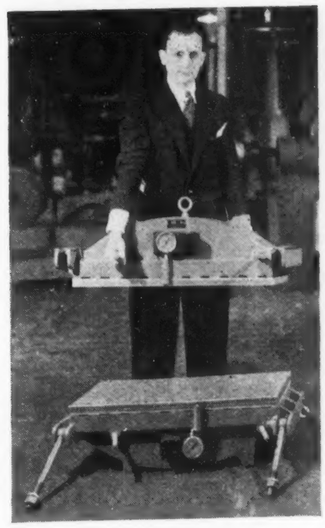
FATALITIES AND DEATH RATES AT UNITED STATES COAL MINES, BY CAUSES *
January–October, 1935 and 1936

Cause	Bituminous: Number killed 1935	Bituminous: Number killed 1936	Bituminous: Killed per million tons 1935	Bituminous: Killed per million tons 1936	Anthracite: Number killed 1935	Anthracite: Number killed 1936	Anthracite: Killed per million tons 1935	Anthracite: Killed per million tons 1936	Total: Number killed 1935	Total: Number killed 1936	Total: Killed per million tons 1935	Total: Killed per million tons 1936
Falls of roof and coal	414	455	1.378	1.317	117	102	2.707	2.419	531	557	1.545	1.437
Haulage	157	133	.522	.385	23	18	.532	.427	180	151	.524	.390
Gas or dust explosions:												
Local explosions	11	17	.037	.049	10	11	.231	.261	21	28	.061	.072
Major explosions	9	18	.030	.052	13	5	.301	.119	22	23	.064	.059
Explosives	28	20	.093	.058	15	13	.347	.308	43	33	.125	.085
Electricity	33	29	.110	.084	1	6	.023	.142	34	35	.099	.090
Mining machines	20	13	.066	.038	1	....	.023	.....	21	13	.061	.034
Other machinery	3	9	.010	.026	....	2	.....	.047	3	11	.009	.028
Miscellaneous:												
Minor accidents	23	32	.076	.092	11	16	.255	.380	34	48	.099	.124
Major accidents	6	9	.020	.026	....	....	.....	.....	6	9	.017	.023
Shaft:												
Minor accidents	8	8	.027	.023	3	7	.070	.166	11	15	.032	.039
Major accidents	...	...	.....	.....	7	....	.162	.....	7	....	.020	.....
Stripping or opencut	4	7	.013	.020	7	7	.162	.166	11	14	.032	.036
Surface	33	30	.110	.087	25	12	.578	.285	58	42	.169	.108
Grand total	749	780	2.492	2.257	233	199	5.391	4.720	982	979	2.857	2.525

* All figures subject to revision.

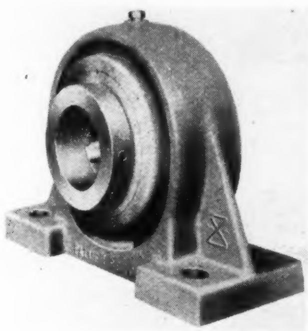
WHAT'S NEW

In Coal-Mining Equipment



PILLOW BLOCK

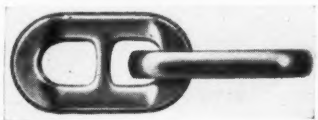
Palmer-Bee Co., Chicago, offers a new self-aligning pillow block developed to simplify alignment of shafts and to take care of light or heavy shock loads at either high or low speeds. Features pointed out by the company include: cast-steel housing, enabling the pillow block to withstand a greater shock load than a shaft of corresponding diameter; true ball-and-socket principle of operation resulting from machine finishing of the housing to a spherical surface and fit that permits a free oscillating movement of about 3 deg. in any direction and at the same time maintains an unbinding accurate alignment of the shaft; Hyatt



heavy-duty precision bearing in a dust- and dirt-proof machine-finished housing; and infrequent lubrication, adapting the unit to installation in difficult-to-get-to places. The pillow block is available from stock in all standard shaft sizes for all types of services. Special sizes also are available.

CHAIN

American Manganese Steel Co., Chicago, announces a new dragline bucket chain for which it notes the following: increased strength; full line instead of point bearing between links; additional metal on sides of links where wear comes; lighter weight; tie bar across link to prevent snarling and kinking; equalized metal sections, insur-



ing perfect heat-treatment in manufacture and consequent better physical properties; clean lines, making for clean castings; and the use of heat-treated austenitic manganese steel, combining strength, toughness and wear resistance.

FLASHLIGHT

Inertia Devices, Inc., Albany, N. Y., offers "Megolite" flashlights with a recently patented inertia switch. The following advantages are claimed for the light: thorough insulation against static and dynamic electricity; complete sealing and gasketing against the entrance of water, gases or vapors; elimination of all external moving parts or switches; and approval by the U. S. Bureau of Mines. The switch is operated by "fly-casting" flick of the wrist.

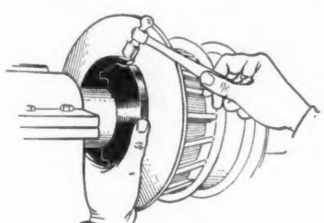
LOADER

General Conveyor & Mfg. Co., St. Louis, Mo., offers a new small loader for use in picking up screenings from ground storage. Capacity, according to the company, is 1 ton per minute on material up to 6-in. lump. The loader is mounted on a three-point frame with a single front wheel for swiveling and fan-tailing the machine. Steer-

ing is accomplished by a large handwheel conveniently located. A hand lever controls the propelling mechanism. Moderate cost and either gasoline or electric power are stressed by the maker. The boom can be flattened when moving the machine around.

THRUST COLLARS

Quick Repair Washer Co., Indianapolis, Ind., offers the "Quick Repair" washer and thrust collar in both standard and special sizes in either malleable or bronze for installation directly on the shaft without tearing down the equipment. Thus, according to the company, only a few minutes is required to take up excess play in excavating machinery, locomotives,



road machinery and other equipment. These split thrust collars or washers consist of two interlocking grooved parts which slide together and are locked by tapping the overlatch in place.

VULCANIZER

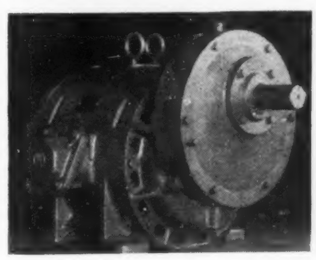
B. F. Goodrich Rubber Co., Akron, Ohio, now offers the No. 28 aluminum one-man vulcanizer weighing less than 300 lb. and said to equal the efficiency of any vulcanizer for transmission and conveyor belts up to 28 in. as well as possessing the added advantage of ability to vulcanize narrow transmission belts up to 10 in. and 6 plies in one heat. The unit is available for 110 or 220 volts a.c., d.c. or a.c.-d.c. The d.c. type may be changed to a.c. of the same voltage by changing the plug-in connections on the side of the vulcanizer, which comes equipped with curing pad and galvanized-sheet covers. No clamping bars are necessary.

RESPIRATOR

H. S. Cover, South Bend, Ind., offers the new "bulb valve" Type No. 24 "Dupor" plate respirator for use in Type "A," or pneumoconiosis - producing, dust. It bears Bureau of Mines approval stamp BM 2111. The new unit, according to the manufacturer, features a greatly enlarged area in its double filter chambers. The filter aperture for both pads is more than 24 sq.in., and dead air space, it is stated, has been cut to a minimum. Under this new construction, weight of the actual respirator, without filter pads, is reduced to 4 oz.

MOTORS AND CONTROLS

A new line of single-reduction explosion-proof gearmotors from 1½ to 75 hp. has been announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for application in Class 1, Group D hazardous locations. Advantages cited by the company include: compact design, high efficiency, single-helical-type gears

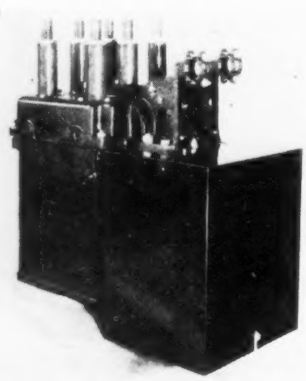


with "tough-hard" heat-treatment and anti-friction bearings.

Westinghouse also offers a new and improved design of the Type SK explosion-tested

fan-cooled totally inclosed direct-current motors. Available in sizes from 5 to 75 hp. for 115, 230 and 550 volts, these motors are designed for use where explosive gases or dust may be present. Brushes and commutator, it is stated, are readily accessible and the motor is designed with the fan on the commutator end so that a gear case, coupling or pulley will not restrict ventilation. Accessibility is obtained by the use of a double-walled bracket on the commutator end. This bracket is equipped with hand-hole covers which are readily removed to permit inspection and adjustment of brushes and commutators. Each cover is provided with a hole in the web for insertion of either a wire meter seal or chain and lock.

For indoor service, Type F-122 solenoid-operated oil circuit breakers rated at 25,000 kva. are offered by Westinghouse in manually or electrically operated models for service up to 600 amp., 7,500 volts and 800 amp., 2,500 volts, two- and three-pole single-throw. Installation of the operating levers inside the breaker chamber removes them entirely from



the vicinity of live contact terminals, thus, it is said, eliminating the necessity of carrying the moving contact lifting rod through the main breaker-top base, as well as the possibility of unbalanced forces on the lifting rod which might retard the opening movement of the contacts or cause pumping when these levers pass through the main frame. The inclosed arrangement of operating levers leaves the outside of the breaker structure with a neat, trim appearance.

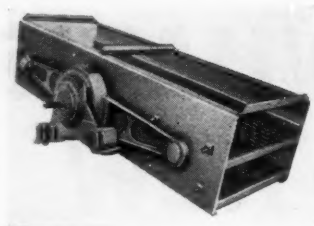
Manually operated breakers may be arranged for panel or panel-frame mounting, direct control, and for wall, pipe or structural-steel frame mounting, remote control. The manual mechanism is suitable for mounting on either a panel or panel bracket, and is mechanically trip-free, so that it is impossible to hold an automatic (cover-plate with various overload devices) breaker closed against a short circuit. Electrically operated breakers may be arranged for wall, pipe or structural-steel-frame mounting. The Type SAF-2 solenoid-operated mechanism is a separate unit for mounting directly on the breaker. This mechanism is

fully automatic and thus it is impossible to hold the breaker closed against an overload on the line.

Westinghouse also offers a new line of polyphase detachable meters suitable for any a.c. application where a two-element watt-hour meter is required. All of the advantages characterizing the single-phase detachable meter have been incorporated in the two-element line, says the company, and with two complete elements and disks they may be applied on the same basis as corresponding conventional polyphase meters. Four types (CS-2, CS-5, CS-7 and CS-8) are available for various classes of service.

VIBRATOR

Productive Equipment Corporation, Chicago, offers, in addition to its regular line, a "Selectro" vibrating screen designed for use where corrosive materials must be handled. Improvements are stated to include the use of stainless steel throughout and the employment of a selective throw to vary the stroke of the screen in accordance with variations in the character of the material handled. Eight positions allow, it is pointed out, selection of the



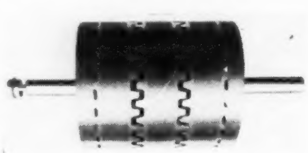
proper stroke without shutting down the screen. This is a feature of all Selectro screens. Other announced improvements are the use of oil instead of grease and a method of changing the tilt of the screen while it is in motion.

ELEVATOR BELT

United States Rubber Products, New York City, has added the "U. S. Bucket Belt" to its line of elevator belts. Designed to handle lighter stone, coal and similar materials, the new belt is made with a specially designed 32-oz. duck body and high-grade cover and, according to the company, "should prove particularly valuable as an intermediary belt between the heavier-duty and lighter-weight elevator belts."

MAGNETIC PULLEY

Dings Magnetic Separator Co., Milwaukee, Wis., offers a new magnetic pulley said to have 50 per cent greater radiating surface than other structures heretofore supplied. Horizontal and radial ducts for air currents are ribbed to increase radiating



surface. The conveyor belt forces air downward through the radial openings and out through the longitudinal ducts, thus quickly dissipating heat generated in the coils. The corrugated air passages, it is stated, increase magnetic pull as much as 20 per cent under actual operating conditions.

GALVANIZED SHEET

American Rolling Mill Co., Middletown, Ohio, now offers a new kind of galvanized sheet which it states assures a good paint bond on iron and steel products. Known as "Armco Galvanized Paintgrip" sheets, this galvanized sheet metal, it is declared, can be painted without special treatment of the surface by the user. They are available in any of the grades of galvanized sheets manufactured by the company and the base metal can be either Armco ingot iron or plain or copper-bearing steel. When required, all grades can be supplied stretcher leveled. Forming qualities of Armco Paintgrip sheets are the same as untreated galvanized sheets and they may be soldered satisfactorily with the use of hydrochloric acid as a flux. Practically any good paint can be applied to the sheets, it is stated.

SHOVEL CONTROL

Link-Belt Co., Chicago, offers the "Speed-O-Matic" control for shovels, cranes and draglines, now furnished as standard equipment on Link-Belt K-40, K-45, K-48 and K-480 shovel-dragline-cranes. The control is of the power type with short "easy-

throw" levers. Major advantages cited by the company are: elimination of operator fatigue, much speedier operation and greater output.

COPPER COATING

Pure metallic copper of extreme fineness and of the irregular, flaky structure known as "dendritic" can now be applied to iron, steel, wood, concrete or other surfaces which require a protective coating of unusual effectiveness, declares American Coppercote, Inc., New York City, in introducing its new "Coppercote" preservative. Coppercote is described as minute flakes of pure metallic copper in suspension in a special vehicle. When applied to a ferrous-metal surface, it is asserted, it will positively prevent corrosion or, if the surface already is rusted, it will prevent further corrosion. It will not crack, scale or chip under extremes of temperature and is not affected by exposure to sunlight. Coppercote also is said to be a non-conductor of electricity, extremely fire-resistant and waterproof.